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FREE SOFTWARE AND INTELLECTUAL PROPERTY IN BRAZIL: THREATS, OPPORTUNITIES AND MOTIVATIONS

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Abstract. This article discusses the implications of the intellectual property system as applied to software, especially the use of patents, for innovation in developing countries; it also assesses the possible consequences of the appearance of free software and a new intellectual property system in the innovation process in countries such as Brazil; finally, it attempts to analyse the new dimension of intellectual property as well as its context in the current debate on 'global patents' as opposed to a more flexible copyright system. Some of the questions discussed are: Is a more flexible copyright system an instrument to promote technological innovation? Does the reduction of the income of some software companies in developed countries point toward an exhaustion of the sales model of user licenses for software? What are the threats and opportunities for the new business model based on free software and copy left in Brazil? Can the motivations for the use and development of free software promote the Brazilian software industry?

1. Introduction

The current economic scenario is marked by the intensive use of knowledge and by the importance that intellectual property has been gaining as a competitive factor for the development of nations. Within this context, the appearance of so-called free software (FS) or Open Source Software (OSS) introduces new modalities of expression and exercise of copyrights, which traditionally protect the inventors of computer programmes. These new modalities are not neutral regarding incentives and the innovation process in the area of software, especially in developing countries.

The spread of FS raises certain issues of an institutional nature. It is argued that this type of protection of software copyrights may become a powerful instrument in the promotion of technological innovation and even in the economic valorisation of authors' intellectual property assets. By facilitating the generation and spread of innovation, the free software protection system would give more opportunities for the author to profit than those allowed by the traditional property system, in which relatively few companies tend to appropriate the majority of benefits generated by the business.

This article is divided into three sections. In the first section, we analyse what would be the most adequate intellectual protection system for software and its implications for the spread of technologies; next, we approach the new dimension of intellectual property and its context in the current debate on global patents; the third section presents the threats and opportunities for the new type of business based on free software and the motivations for its use and development. Finally,

we put forward the conclusions we draw from the issues discussed throughout the article.

2. Software protection systems and their implications for the spread of technologies

The debate over the most suitable regime for protecting intellectual property rights over software is nothing new; the problem dates back to the early 1980s. The question that came up at that time was whether there was need for a special regime for protecting software (Sherwood, 1990). Among the modalities or forms suggested were copyrights, patents, corporate secrets or some sui generis approach. This last idea was discarded because it would be difficult to obtain approval from all the countries that had signed the agreements for intellectual property protection. According to Sherwood (1990), the adoption of any of the forms in existence could be covered by the international treaties in effect, such as the Berne Convention and the Paris Convention.[1]

The debate was temporarily set aside with the conclusion of the Uruguay Rounds, in the scope of the GATT, in 1994. The TRIPS agreement established, in Article 10, Line 1, that computer programs, codes, fonts and objects will be protected as literary works by the Berne Convention (1971). But the rule defined in TRIPS was insufficient to unify the protection regimes applied by the various countries.

Brazil, as a signatory to the Agreement on Trade-Related Aspects of Intellectual Property Rights of the World Trade Organization (TWO-Trips), has accepted the principle that grants to computer programmes the copyright system as defined by the Bern Convention. In the United States, patent protection is used for software, whereas, in the European Union, Poland voted against the proposal to patent software, thus removing, at least temporarily, this issue from the European Parliament's agenda.

The discussion concerning what protection system is most adequate for computer software is a heated one, involving the issue of whether computer programmes are closer to an intellectual work, thus deserving the copyright that is granted to them, or to an invention, which would mean that they should be protected by a patent. The adoption of one of these systems – patent or copyright – entails fundamental consequences, not only in the legal field but, what is far more important, in the economic one. Opinions usually vary according to the interests of the countries involved, even though there is no general agreement even within the borders of each country.

The evaluation of the consequences of the regime for protecting software in the area of innovation should take into account both the specific character of the regime and the object being protected. Buainain et al (2005), draws attention for the double nature of patents: on the one hand, patents give inventors the monopoly for exploiting the protected object. But on the other hand patent holder must divulge

[1] Although the author considers it possible to apply any one of the three forms in existence, he recognizes that each modality protects in a particular way. Copyrights applied to computer programs protect the expression of an idea but not the idea in itself. Patents, in turn, protect the idea that served as the basis for the development of the software; and corporate secrets protect the idea that served as the basis for the development, and cannot be distinguished from the use of the program or the inspection of the expression. These differences are central for the argument presented in this paper.

useful information about the invention, that can be freely used by others. Conceptually, the opening of information required in order to register a patent operates as a powerful instrument for spreading knowledge that individuals or groups other than the holder can use for their private benefit. This is the point of the prospective function of a patent, a factor that has been seriously neglected in developing countries.[2]

In addition, the monopoly granted by a patent does not necessarily imply exclusion. In fact, the definition of clear property rights also contributes to the promotion of innovation. On the one hand, in sectors characterized by complex, costly and high-risk innovations, even large companies find it hard to deal with the full range of knowledge needed to innovate. In this case, what usually happens is that each of the various agents involved holds only some of the conditions needed to innovate. In this case, patents allow companies to negotiate intangible complementary assets that make innovation possible. Even rival companies know that agreements are the best way to limit costs, reduce risks and accelerate innovation processes. Rather than being obstacles, patents and cross licensing operate, in these cases, as strategies used by companies to remove barriers to competition and innovation. On the other hand, the main mechanism for the best economic and financial exploitation of patents is licensing, which plays an essential role in promoting innovation, especially in developing countries. Without it, highly industrialized countries such as Brazil, China, Korea and South Africa could hardly have built up their industrial parks in less than half a century that today represent a significant part of their GNPs. In this regard it is undeniable that patents cannot be seen only as a mechanism for protection and monopoly, but also for spreading knowledge and innovation. The question is to what extent these arguments apply to software companies. Patents or copyrights, that is the question.

Even among Brazilian legal scholars, there is a disagreement about what is the most adequate system for computer programme. Defenders of the patent system argue that the contents that are to be protected in the software are different from those of a piece of literature or work of art. Such a work is defined by the fact that creativity lies in the mode of expression, whereas, in the software, creativity lies in the process, the mode of expression assuming a secondary role. In the first case, it is fitting to apply the copyright system, which protects the expression more than the actual contents; in the second case, however, the creative process resembles the invention of a process, and patent protection becomes applicable.

There are two significant differences between these two systems, with both legal and economic implications, i.e., the term of the protection and the object under protection. The first of these differences shows that, in the patent system, the term of the protection is of 20 years and, for copyright, particularly in the case

[2]In November, 2000 the U.S.A. altered its rule on disclosure to 18 months following the concession of a patent. The relevant technological information (the patent application) remains unknown to the public as long as the patent has not been granted. Authors such as Tang et al. (2001) call these patents "submarine", or non-visible patents. Applicants may request changes in the patents, often using vague allegations, and in this way have the time for disclosure extended over the regular 18 months. Only when the technology is mature do these patents come to the surface; when they become visible, they often surprise competitors, which discover that their new products are infringing on patents pending. This practice makes not only the prospective function of a patent impossible. It also threatens the very social contract built into the patent, which is the essence of the granting of the temporary monopoly: make information about protected technology available to the public as a condition for granting the monopoly right to exploit the innovation.

of software, the term is of 50 years. Considering that a computer programme will usually become obsolete in a short period of time, society will not benefit from the knowledge contained in the code that originated a specific computer programme after 20 or 50 years of protection have elapsed.

From this point of view, one might consider the choice between the patent and the copyright systems to be indifferent. This would be a mistake, however. From a conceptual point of view, a patent grants a private monopoly, but, in exchange, allows private data to be used by society. But if such data is no longer useful when it is made available, one could argue that society is not striking a good deal; in this case, the monopoly would not contribute to the promotion of innovation in general, but would only be an incentive for the holder of the protection.

In the case of copyright protection, the picture is altogether different, more favourable to innovation and to society. Works under the protection of copyright must circulate in order to accrue value. A book, a disc or software under the protection of copyright that is not sold or licensed generates no profit for its author other than prestige (paternity right). Besides, granting a copyright does not restrict new creations very similar to another one provided they are expressed differently from the original. The same story can be told in many different ways, the same idea spread with different appearances, and protecting the author of one of those does not inhibit the initiative of the others. On the contrary, a story that is commercially successful will certainly favour many versions, because each one is meant for a specific public, moulded on different media, etc. In other words, copyright protection does not restrict the spread of information, knowledge or ideas contained in a work; on the contrary, it whets the curiosity, stimulates creativity, and the deepening of ideas and topics dealt with in the work under protection. Transferring the same reasoning to the case of software, it is not difficult to understand why this system, while ensuring the protection of the owner's rights, also stimulates competition and the continuation of the innovation process. The presence of successful software on the market will stimulate competitors to develop a similar and better product without, however, infringing upon the rights of the authors of other products. This dynamics transfers competition from the arena of the special monopoly granted by protection to the economic one, in which leadership and market share will depend on entrepreneurship, distribution network, attention given to clients, reliability, periodical updating and other such factors. Microsoft, the leading industry in software, would probably not have been consolidated if the system of protection were the patent one.[3] It is precisely to reinforce the position of American companies, leaders in the area, that the new intellectual property system in the U.S. included two crucial areas for the registering of patents, i.e., genome and software (including mathematical algorithms).

According to Coriat (2004), the possibility for patent algorithms "cleared the way for patenting software". It appears that, by granting exclusive licenses the new intellectual property system, aimed at ensuring that the advantages of American advanced research would be transformed into competitive advantages, to the detriment of "rival" companies.

[3]The suit that Apple brought against Microsoft was based on the idea that the idea and the concept of the Windows system was a copy of the operational system used and protected by Apple. Microsoft won the case by showing that the idea, although similar, was expressed in a different way, if compared to the Apple programmes.

In information technology, the products of knowledge are inputs for other areas of innovation, and for this reason the grant of patents endangers innovation in general, especially in developing countries. A situation similar to that of preventive patents is thus created, which will hinder enterprisers and innovators from freely developing an "idea" that has already been introduced without having to pay intellectual property rights. In such a system, there is a high potential for paralysis of the innovation process and conflict regarding innovations. On the one hand, given the cumulative nature of innovation and the difficulty to obtain data about patent registers in the world, software protection in this system will increase the uncertainty that is itself inherent to innovation. At any moment, the creator/inventor may be taken by surprise by the charge of rights over patents previously registered, whose basic ideas were incorporated to the new software in good faith. It is obvious that this risk might restrict the process in some strategic areas, in which large corporations already rule above others. Small businesses that currently contribute for incremental innovations that are of great importance to the market by changing the original product in a way that is legal under the copyright protection system will lose legal basis to act in such a way. On the other hand, the same asymmetry in the available information might further deepen the dispute over rights, since the application of patent to software always leaves room for controversy and possible legal disputes. The result is the raise of transaction costs involved in the creation of the software, an unfavourable factor for the small businesses that currently act on this market.

The other difference is related to the object that is protected in each system. In the patent system, the objects of protection are the ideas, systems, methods, algorithms and programme functions, thus guaranteeing protection of all their components. In the copyright system, what is protected is the mode or form of expression, and not the idea implicit in the work. In this point, the computer programme patent will entail a barrier to competitiveness on the software market by defending the idea and the algorithms implicit in it, binding technological innovation to the exclusive use of the title-holder of the corresponding rights for a 20-year term.

We have thus seen that the most relevant argument against adopting the patent system for software is related to the possibility of protecting the implicit idea of the software, as stated by Grossi (2004, p. 5): "The fact that the idea must be shared is a competitive and developmental prerequisite of the software market... The adoption of the patent protection system for software would end up making the whole market impossible, since it would bind the use of a solution in other programmes to the payment of specific royalties. The programmes that are available on the market are by themselves very similar, varying, as a rule, only in some functional and visual particularities".

Defenders of the patent system argue that their point of departure is rewarding the inventor with the temporary monopoly of the invention, which is appropriate to the sectors that invest many years and large sums of money in order to develop a programme, and that this promotes innovation.

Opponents of these ideas see patents as a means for the company to survive without innovation. For Stallman (1991), patents are land mines for programmers, because they will run the risk of stumbling over a patent that may be able to hamper or destroy the project of a software design. In this sense, Grossi (2004, p. 7) supports the primacy of software copyright "under pain of eliminating the

competitive factor from the market, favouring large corporations that, holders of a vast number of patents, would be unable to determine what kind of technological innovation would be implemented at a certain time".

The application of patent protection for computer programmes can also cause the reduction of innovation in the area of information technologies due to the absence of competitiveness. In this direction, Torvalds and Cox (2005) argue that software patents do not promote innovation and R&D, since they are detrimental to small businesses, weaken the market, raise expenses with patents and increase market barriers.

The industry of proprietary software has developed efficient market barriers and enough market power to operate within a high margin of profitability (thus compensating through price the predatory action of non-authorized copies). In the case of the North American software industry, the software patent is a powerful institutional barrier for entering the market. Other barriers mentioned in the literature are represented by the need for minimum scale-level, diversified products and goods, the creation of associated services networks and the need of capital for the investment in technology, marketing and commercialising expenses.

Buainain and Mendes (2004) state that the entry of free software onto the market – with a new intellectual property system, the copyleft, which we present in the next section – changes this situation and makes it possible for many of the barriers to the entry of new competitors to be overcome. Because it is based on open source patterns, the generation of free software benefits greatly from the network economies,[4] associates competences at a low coordination cost, reduces production cost, the need for capital to be invested in R&D, as well as the size of the minimum scale of sustainable production. These factors strengthen the national software industry in developing countries, promoting technological innovation, which would be impossible if the patent regime was adopted.

3. Global patents versus more flexible copyright

It is in this scenario of discussion about the uses of knowledge, patent monopoly as opposed to the sharing of knowledge, and the importance of intangible assets for economic development – as much for peripheral as for central nations – that copyleft appears as a proposed alternative system for regulating intellectual property. Colares (2004, p.6) states about this system: "With the appearance of the free software and the open source software, emerges what one has agreed to name copyleft. As opposed to the copyright system, in which there is a primacy of economic rights on copies, to the detriment of other interests, including moral, the copyleft system is accurately defined as the permission given to the general public to redistribute freely a computer programme or other authorial works."

Free software is referred to four different specific freedoms given to the user: (i) freedom to run the software to any end; (ii) freedom to study the software so as to understand how it works and to adapt it in any way; (iii) freedom to distribute and share the software; (iv) freedom to improve the software and redistribute such changes so that everyone may benefit from it.

[4]Network economy is a concept presented by Shapiro and Varian (1999) as refers to the fact that it's better to be connected to a large rather than to a small net, and this the larger the better feature generates the positive feedback, which happens when a system benefits from the its larger number of users, making new users to adopt the same system.

Free software is also based on authorial right, with the difference that the author chooses to let the user use, study, change and redistribute the programme he or she created.

As many imagine that FS is spontaneously or voluntarily produced and that therefore it can be appropriated and used at no cost, it is important to emphasize that free software does not necessarily mean software free of charges.[5] In practice, the OSS system does not deny the property right, but changes the contractual relationship between owners and users. Whereas in the copyright system, the owner licenses the use of a copy of the protected asset – and thus get paid –, in the copyleft system, remuneration comes from the sale of services based on the use of software available for general use in the free category. Its adoption changes the approach from a property to a services contract. The freedom to copy, change and redistribute associated with OSS is not dependent on the absence of costs. In the case of property software, its copy, redistribution or change is, to some measure, forbidden by the owner, and it is necessary to ask for permission or pay in order to use it.

It is the author of a computer programme who chooses whether to make a software available in the FS category. Therefore, he or she may use their rights, making the programme flexible enough to allow the use of their work by others, according to the General Public License (GNU), an integral feature of the copyleft concept.

Concurrently with the spread of free software, the Substantive Patent Law Treaty is being discussed in the World Intellectual Property Organization, in order to harmonize the granting criteria, establishing a pillar for the global patent project. The Treaty goes beyond the Trips Agreement, which establishes criteria for patenting – novelty, inventive activity and industrial applicability – without, however, determining how these criteria should be applied. This gap allows for each country to decide as to this application, with the result that some inventions may be patented in a country and not in another, the very case of software, patented in the U.S. but not in the majority of other nations. The Treaty, in its turn, establishes that a patent granted in a country, in accordance with the terms internationally agreed, would necessarily have to be approved in the other signatory countries.

This would be a major change in the conduct of international agreements related to intellectual property rights, whose application has so far respected the principle of territoriality. The issue under discussion is whether the global patent may contribute towards reducing the inequality currently existing among nations, or if, under the pretext of facilitating patenting in general, will reinforce this inequality, opposing developed and technology holding nations and developing countries.

The Treaty shows the concern that the global patent may limit the authority of countries to control patent rights, eliminate the prerogative to decide whether to grant or not register, besides removing from the competence of national justice the trial and cancelling of patents.

Brazil and other 13 developing countries – including Argentina, Bolivia, Cuba, Egypt, South Africa, Tanzania, and Venezuela – reassert their opposition to global patent, for they consider the treaty a possible new instrument of pressure, including commercial pressure, against developing nations. On the other side stand the supporters of global patents, countries that have a natural interest in it, the

[5] In fact, free software is a misleading expression, and is currently being replaced by "open source" software.

United States, England, France, Germany, Italy and Japan. For negotiators of the southern countries, the project encourages the view favoured by the U.S. that the exploitation of patents can be made solely through imports. That is to say that a North-American company has its patent protected in Brazil, but will only import the product from the mother company, instead of producing it locally. This would strengthen the position of developed countries as patent producers and of developing countries as mere importers, without promoting innovation and economic development. Developing nations fear that harmonizing patents will reduce the current flexibility of certain situations.

The idea defended by developed countries in favour of this Treaty promotes the extension of global patents, one of whose consequences is the creation of institutional barriers that can hinder growth in developing countries by inhibiting the production of local technologies and innovations. It could be mentioned as examples of this institutional barrier – which brings in itself acute economic conflicts between North/South nations – the recent cases involving pharmaceutical companies and the government of South Africa, or the dispute between the U.S. and Brazil concerning the right to appeal against compulsory licensing to produce generics at a lower price (Orsi et al., 2002).

From the point of view of the interests of developing countries, global patent would mean a further step in enforcing unique and homogeneous global rules to deeply contrasted countries. A recent study by the UNCTAD shows evidence to support an unoptimistic view of the positive effects of so-called globalisation and structural reforms for the majority of developing countries. The structural inequalities that separate developed countries from the others would be growing in the last decade, and not reducing, as expected. Global rules that fall upon unequal countries will certainly play a fundamental role in this process.

In this sense, the defence of global patents opposes the movement of making authors' rights more flexible – the exponent of which can be found in free software and copyleft – and the necessary application of the welfare theory that supports social utility as a basis for granting patents and for other intellectual property rights.

4. New business model based on free software: threats and opportunities

Concurrently with the process of evolution and consolidation of the software industry based on the sale of user licenses – as one of the attributes granted to holders of patrimonial rights for intellectual property –, the movement in favour of FS also appeared and evolved, disputing the restrictions to access and freedom for the development and change of software. The use of FS became widespread in the whole world.

While this expansion happens, there are also signs of retraction in the earnings and loss of dynamism of North American software companies. The poor performance of many leading software companies cannot be ascribed only to the weak performance of world economy, but is also the result of an exhaustion of the user license sales model, of piracy and other means of commercialisation and access to products.

In this context, the arrival of free software on the scene shows potential as a new business model. Proprietary software is based on property licenses whereas

free software is based on services. The strategy of free software producers is to sell development, training and specialized support, whereas proprietary software owners profit basically from collecting licence fees over long periods from customers trapped by the technological imprisonment[6] caused by the use of the software.

Products based on information technology undergo frequent changes, a fact that leads to situations of imprisonment. Shapiro and Varian (1999) show how this imprisonment consists of three phases, namely, (i) choosing a brand, (ii) experimentation, and (iii) entrenchment.

The supposedly "free" choice of a brand is actually free only at the beginning, when the competition is most intense. But once a buyer has decided to use a given brand, the imprisonment considerably reduces the client's freedom to choose some other brand. This is a classical problem treated in the scope of theories of competition, and arises in many different types of markets. It explains the "loyalty program" strategy used in many segments where technological imprisonment is low. The objective of such programs is to raise the customer's costs in changing over to other brands. By offering a bonus to customers willing to trade in an old car for a new one of the same brand, for example, the seller introduces a cost (the loss of the bonus) if the consumer decides to switch brands. Even in the best of circumstances in the area of computer programs, there is always a certain degree of technological imprisonment related to the cost of learning how to use the software, and this cost tends to increase with the complexity and the importance of the program in a company's everyday operations.

In the second, experimental, phase the user tests the program and weighs the pros and cons related to using it. In the third phase, entrenchment, the consumer gets used to the brand and gradually gives it preference over others. The longer this last phase lasts, the higher are the costs of a changeover, leading to imprisonment and preventing migration to other technologies. Figure 1 shows the cycle of imprisonment and its phases, as described above.

The types of imprisonment that most affect software are information, databanks, searching costs, training, incompatibility of systems and constraints imposed on the whole chain, which is based on a given line of technology. The need to preserve data already in existence is the most serious type of imprisonment, and limits migration to other programs. New software must therefore be able to read and save data related to the leading software products on the market. This must be an option for users, as it reduces imprisonment.

In view of these factors, one cannot say that free software automatically represents an alternative to the technological imprisonment imposed by proprietary software. At least in conceptual terms, free software can bring about as much technological imprisonment as proprietary software does. Whether there is imprisonment or not depends on the business models involved and the strategies adopted by the companies that use free software in their business. Companies can use strategies to reduce imprisonment as a way to convince users to adopt the respective software.

[6]Shapiro and Varian (1999) characterise technological imprisoning as the dependence on technology chosen by a company due to the difficulties involved in replacing such technology with another. It should be mentioned that any software will create certain degree of dependence, including free software. However, free software is not designed to exclude the use of other software and tools. On the contrary, FS developers gain from promoting interactions between different platforms and keeping flexibility to a maximum. These features are likely to reduce technological imprisonment.

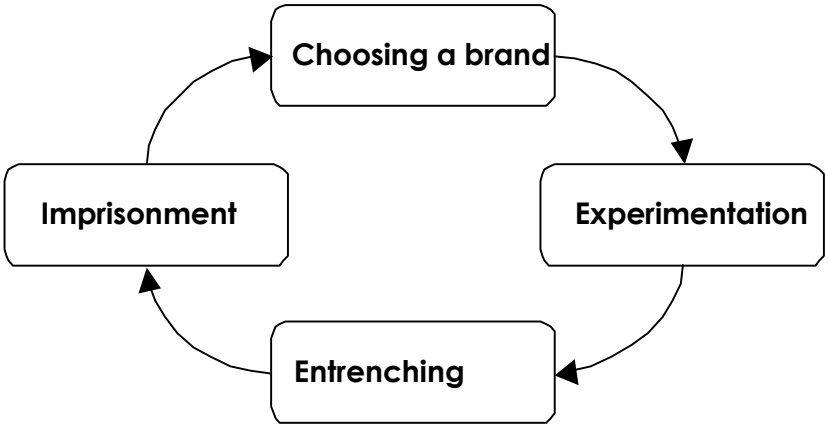

FIGURE 1. The cycle of technological imprisonment (source: Shapiro and Varian, 1999).

Therefore, it is not correct to assume, from the start, that free software is necessarily advantageous. The user should analyse the cost-benefit relationship before choosing one or another type, after studying the implications of change, payment or not of licenses, installation, migration of data, inherited files, training, and other factors.

It can be concluded, therefore, that free software may end up demanding constant innovation if a manufacturer wants to hold onto its clientele, whereas proprietary software can stay on the market based on the advantages associated with the difficulties in making changeovers. In practice, this involves a different strategy, aimed at breaking down the barriers of competition created by the leading companies, based on the copyright regime.

In this context, the emergence of FS industry appears to be a potential new business model. Whereas proprietary software is based on property licenses, that of FS is based on services' sales. The strategy of FS producers is to sell development, training and specialized support, while the owner of proprietary software lives on the technological imprisonment[7] of its clients by means of payment of user licenses. FS would demand permanent innovation to maintain its clientele, whereas proprietary software would ensure the market based on advantages resulting from the difficulties posed to changes. In practice, this is a different strategy, aiming at the elimination of competitive barriers created by leading companies based on the copyright system.

The elimination – or the minimisation – of competitive barriers is fundamental for developing countries like Brazil, which are altogether different from those of a developed country. Such characteristics are used in favour of adopting free software in the country, a few of which are low computerisation of national companies in general, the restricted availability of financial resources, the strong social inequalities,

[7]Shapiro and Varian (1999) propose that technological imprisonment may be described by the dependency upon the technology chosen by a certain company due to the difficulty of changing this technology for another one.

which entail structural obstacles for technical training and access to computerized resources.

This scenario is favourable to the strengthening of FS in developing countries. Thus, a survey conducted in Brazil by Salles-Filho and Stefanuto (2005) to determine the modes of technical and economic organization of the FS industry, to which there were 3657 respondents – developers, specialised companies, consumers, users – has indicated the main threats and opportunities for Brazilian companies regarding the use and the development of free software.

The survey suggested that the threats lie in the development of software components because this is a market that can be disputed by the emergence of free-access component banks. Customisable products are threatened to a lesser degree because they have a certain specificity that is not threatened by FS. The opportunities given by free software lie in the services sector (of low or high value)[8] and in embedded software. Embedded software does present opportunities due to its very specificity and the low requirements for appropriability (related to the equipment and because it can do without legal systems that are restrictive to property).

The low requirements for appropriability of embedded software point at opportunities for the national software industry. As opposed to this, high-priced software displays just as many signs of threats and opportunities because they are highly specific and have a medium degree of appropriation.

We thus see that the appropriability requirement is a relevant factor for the definition of opportunities in the FS segment because it represents a barrier to entry that can be minimized or strengthened according to degree and costs.

Besides threats and opportunities, the study mentioned above has also suggested the motivations for the development and use of FS, which are of various natures, technical, economic-financial, ideological and related to training, with a superposition of the technical issues. These issues are related to flexibility, safety, power of adaptation, and interoperability of programmes. We thus see that technical motivations are related to the protective system for intellectual property applicable to free software – copyleft –, which allows the user to study, adapt, change and redistribute the software. Those of an economic-financial nature refer to the reduction of operational and capital costs – eliminating the payment of licenses and reducing the fee for renewing the hardware. Those of training relate to the possibilities of shared learning, which may extend the conditions of employability of developers. And, finally, ideological reasons are manifest in principles contrary to the restriction of use and of the advancement of knowledge and to the economic concentration by oligopolies and monopolies, as well as principles favourable to social inclusion among those shown in Table 1.

[8]The categories are: low-value services, high-value services, customized products, components, embedded items and parcels.

Reasons	**Average**[9]	**Standard deviation**
Greater flexibility/freedom to adapt	2.68	0.69
Greater security/privacy/transparency	2.53	0.64
Greater autonomy in terms of suppliers	2.30	0.82
Higher quality	2.28	0.72
Lower costs (hardware and software)	2.18	0.75
Digital/social inclusion	2.03	1.00
Better scalability	2.00	0.60
Philosophy/principles	1.98	0.97
Greater legality (licenses)	1.85	1.00
Takes less time to develop	1.48	0.82
Availability of qualified human resources	1.48	0.78

Table 1 – Motives for developing and using free software (Source: Salles-Filho and Stefanuto (2005)).

The technical reasons are clearly related to the regime of protection of intellectual property applicable to free software – copyleft – which lets users study, adapt, change and redistribute the software. Economic and financial reasons are related to lower operational costs and less capital – no licenses to pay, less need to upgrade hardware, etc. The items related to training include possibilities for shared learning, which can improve chances for hiring developers. Lastly, ideological reasons can be seen in the principles contrary to restrictions to the use and advance of knowledge, and to the economic concentration represented by the monopolies, as well as principles in favour of social inclusion.

Salles-Filho and Stefanuto (2005) state that the actors involved in free software – large national corporations from various sectors, small businesses, hackers, governmental agents, major consultants, universities, research organizations – have different motivations for developing free software, and technical advantages are an appeal to the different perspectives that coexist in the world of free software, its development depending on all such actors.

The development of the free software model has ushered in a transitional stage for the Brazilian and international software industry, and its implications for a peripheral country like Brazil differ from those seen in central countries. The Brazilian software industry went through a period of growth in the 1990s, of approximately 13% a year. But during the same period a number of transnational companies moved into the country, causing a reduction in the slice of Brazilian companies in this market segment. The outcome was that Brazil became more of a software consuming market than a producer. Other factors also contribute to this situation, such as the absence of a national project for the software industry, the country's lack of an image as a qualified producer on the foreign market, and structural weaknesses represented by the difficulty in cooperation and the low qualification in the management and business areas.

The emergence of the free software model may help bring about changes in these structural weaknesses, since the model could serve to backup the development of software products and services with low and high added-value, as described above, as positive possibilities for the domestic free software market. The study by Salles-Filho and Stefanuto (2005) shows that the free software model has the potential

[9]Approximately 50 respondents, grades ranging from zero to three.

to foster greater cooperation among small companies, thus increasing Brazilian capacity in the international community and overcoming structural problems in cooperation with other countries, as well as improving Brazil's image abroad. This process cannot be carried out without action from the Brazilian federal government to define and give priority to an industrial policy that would encourage this sector and provide financial resources to stimulate technological innovation in the country's software industry.

Although timidly, the Brazilian government has fostered the use and development of free software. As an example, Mendes et al. (2005) mention the case of Embrapa,[10] which, through one of its subsidiaries, *Embrapa Informática Agropecuária*, has developed a great deal of free software for the farming sector. This project has put the company in a privileged position as a software developer, rather than being a mere user. Embrapa has also developed free software known as *Árvore Hiperbólica*,[11] a tool that has represented savings in resources worth US $375,000 (funds that would have been spent on obtaining licenses for similar proprietary software). These savings not only make it possible to set up information agencies[12] developed by the company, but also to reinvest in further research.

The conclusion of the empirical study is that the segment of FS may strengthen the Brazilian software industry. According to the authors, "although this is not a technological breakthrough, it is a new way of developing and licensing software, thus breaking with some structural models of appropriability in this industry" (Salles-Filho and Stefanuto, 2005, p. 71). The potential of this protective system lies more in the savings in the productive process, in the innovative business model and in the creation of opportunities to enter onto the market than in the possibility for radically new products' innovation. The growing professional attitude and concurrent overcoming of ideological disputes in the industry are contributing towards the expansion of business based on free software.

5. Conclusions

The new millennium, known as the "millennium of the economy of knowledge", is marked by significant changes in the economic structure of many industrialized countries. Economy, which was previously based on land, capital, and labour – as a result of the Industrial Revolution – is currently based on new intangible assets, knowledge, innovation and creation. In this context, the ownership of these assets becomes at once important and controversial. If institutional barriers imposed by developed countries – such as the extension of global patents – get harsher and consolidate themselves, developing countries will remain marginalized and doomed in the global economy.

The granting of patents to computer programmes may entail a complete inversion of the basis that supported the contemporary intellectual property system, whose aim was to protect the asset and promote the free circulation of ideas in order to foster inventiveness and innovation.

[10]Empresa Brasileira de Pesquisa Agropecuária, a company subordinated to the Ministry of Agricuture and Supply.

[11]A multi platform computational tool for creating and editing a hyperbolic tree based on a friendly and intuitive interface.

[12]Consisting of sites that, via Internet, provide technical and scientific information that Embrapa has generated ever since it was founded, in its numerous areas of operations.

The promotion of the free software environment may become a factor for strengthening the national software industry and become an advantageous business model. This challenge involves the coordination of efforts and forces of the different actors of the process to foster the free software industry in Brazil. The current scenario, with the strengthening of the movement in favour of free software, proves that this can be an efficient instrument of technological innovation, in our opinion "The emergence of free software and copyleft propose a new approach for giving more flexibility to the exercise of the intellectual property right, in the field of authorial rights, which may become an efficient instrument to promote technological innovation in this sector."(Buainain and Mendes, 2004 p. 80).

The protection of intellectual property can be conciliated with the organization of free rights, which in practice gives the holder many different possibilities to use his work (Colares, 2004). The emergence of free software and copyleft propose a new approach for giving more flexibility to the exercise of the intellectual property right, in the field of authorial rights, which may become an efficient instrument to promote technological innovation in this sector. Far from denying intellectual property, the granting of more flexible conditions attempts to preserve the rights – it is the author, as owner, who defines the use conditions of the software – and facilitate economic exploration of the authors' right through a modality that is different from the traditional license sale.

The emergence of the free software has triggered a debate about the urgent need to adjust the regulatory standards of intellectual property to the real conditions of contemporary economy, and particularly to the need to promote the spread and innovation of technology in developing countries and the balance between the degree of legal protection and social interest.

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