Institutional changes and their impacts on the Brazilian Pharmaceutical Industry: Is there an Innovation System on the way?

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Summary

The Brazilian legislation did not recognize pharmaceutical patents for products and processes up until 1996, an exemption which started in 1945 for products and 1969, for processes. In this period, the domestic companies freely reproduced medicines developed by large companies from abroad and commercialized them in the local market with their own trademarks. They applied considerable efforts and resources in marketing, aiming to consolidate their brands next to the medical class, but they did not had to face the costs of research and development (R&D). This strategy guaranteed a considerable profitability for the domestic laboratories, but it was made impracticable by the new institutional landmark that emerged after the regulation of the Patents Law ("Lei de Propriedade Intelectual" – number 9.279 of 05/14/1996) and the Generic Medicines Law ("Lei do Medicamento Genérico" – number 9.787 of 02/10/1999). This article illustrates, through analysis based on information obtained from secondary sources, interviews and a Panel of Specialists, how the new competitive environment forced the companies to adopt a new strategic position, in which innovation gained importance.

Key-words: sectoral system of innovation; institutional change; research, development and innovation; Brazilian pharmaceutical firms.

1. Introduction

This article aims to discuss the changes occurred in the Brazilian institutional plan and how they modified the interactions between the actors of the Brazilian pharmaceutical industry, creating perhaps new elements towards an indigenous sectoral system of innovation. It stresses the role of domestic companies[1], and so because they were much more affected by the new regime established after 1996, with the Patents Law ("Lei de Propriedade Intelectual" – number 9.279 of 05/14/1996) and the Generic Medicines Law ("Lei do Medicamento Genérico" – number 9.787 of 02/10/1999) and created a new competitive environment that forced companies to new understandings of their position and their possibilities.

The article is composed of this Introduction, three development topics and the conclusions. The second topic congregates the methodological procedures, the third recoups literature on Institutional Economy, with distinction to the way the institutions create and regulate the ongoing activities, as well as new patterns of behavior.

The fourth section presents the main alterations occurred in the Brazilian economic-institutional plan recently, the consequent emergency of a new competitive environment in the Brazilian pharmaceutical industry and the positioning of the companies in this new system. We present the reconfiguration of the sector after the emergence of generic medicines, associated to an increasing share of domestic firms in the local market. The perspectives associated to the sale of these medicines stimulated the entrance of foreign laboratories and investments in expansion and modernization on the part of already established companies. Moreover, the paper assembles examples of how innovation, even though punctual and incremental, starts to be incorporated as an element re-defining competition, in great measure because, in the scenario imposed by the institutional changes, the perspectives offered to domestic firms and their traditional way of life is to produce unprotected copies. On a rather reduced space, or to innovate.

Finally, the conclusions of the paper point out that, in the existence of an institutional framework stimulating innovation, the Brazilian pharmaceutical industry seems to direct efforts in research, development and innovation (RD&I), focusing on the creation of new abilities, indispensable to the survival of companies in the new context. Despite incipient, this process of search for innovation in the Brazilian pharmaceutical industry deserves to be studied. Will it be that the new elements allow us to speak of a new trajectory? The paper presents elements supporting this claim, but they are far from unambiguous, and much is yet to be done in order to create a really new environment and an associate dynamics, deserving to be named a sectoral system of innovation.

2. Methodological procedures

The analysis carried out here was based on secondary and primary sources. The first ones comprehend the papers based on already edited pieces about the study subject, as dissertations, theses, articles and documents presented in symposiums and academic congresses. Additionally, a great number of information, for the 2000-2007 period, was collected on companies' websites, the "Organização Pró-Genérico" website, publication Innovation UNICAMP, Brazilian business newspapers "Valor Econômico" and "Gazeta Mercantil", Sectorial BNDES, amongst complementary others.

Carmo & Blacksmith (1998) point out that the use of periodical article as information source allows the gathering of raw data on a given social phenomenon and to disclose the impact that given type of information has on the segments of opinion. However, it was necessary to consider that the information spread through these channels is constructed, frequently, based on market rationalities and logics or diffusion of self-interests.

With the objective of filtering, to compare and to legitimize the data obtained from secondary sources, as well as validating the hypothesis of the existence of a new institutional paradigm in the Brazilian pharmaceutical sector and elucidating the main opportunities and challenges that it represents, the study made use of material collected from interviews and also from a panel of specialists. This panel had the format of a technical Meeting, entitled "Science, Technology and Innovation and the Development of the Pharmaceutical System of Innovation: the Future of the Brazilian Pharmaceutical Industry" and congregated twenty two participants, amid professors and academics, professional researchers from the R&D area of Brazilian pharmaceutical laboratories, and graduate students.

The contributions of Gavigan & Scarpolo (1999) and those of Miles, Keenan & Kaivo-Oja (2002) were important for the choice of this methodological tool. The first authors argue that these panels, even though not seen as a 'methodology' itself, show an important complement to the employed methodology. The second authors point out that panels of specialists are useful in topics that reveal complexity and which contain uncertainty on the data or of its interpretation.

3. A revision of the institutionalist approach

All the historical experiences of supported economic growth – since at least the First Industrial Revolution – have found the conditions that made them possible inside a set of institutions, common norms of behavior and public policies (Cimoli, Dosi, Nelson, & Stiglitz., 2007). The institutionalist approach is inter-disciplinary, gaining influence of politics, sociology, psychology and factors related to other sciences. The inclusion of the institutions into the analysis of the movement of changes helps to contemplate the construction of a theoretical framework which explains the development of trajectories taking in account the technological patterns and their pathways, always in agreement with the social, political, scientific and institutional environment, in one determined historical period (HODGSON, 1998).

For Coriat & Weinstein (2004) it is the institutional norms, routines, common habits, established practices, rules, laws and patterns of behavior of the institutions that mold the action of the

agents and affect their interactions. The authors point out that the influence of the institutions on individual actions provides some stability to the socioeconomic systems, in part for restricting the diverse and changeable actions of the agents. Coriat & Weinstein (2002) suggest classifying the institutions in two types, noting that both contribute to the definition and the setting of 'game rules' for the individual agents: (i) institutions that include a dimension of explicit coercion, imposed on all agents. This dimension is guaranteed by a system of penalties, fruit of a complex social apparatus that imposes operational rules and assure its fulfillment; (ii) institutions related to the rules that individual agents decide 'to impose' on themselves, such as the relations that bind them, the standards they decide to follow – by contracts, conventions or rules established by the agents.

The second type of institutions is complementary to the first ones and this is the reason why the institutions establish the limits and the autonomy of the agents when it comes to the initiative margin they can enjoy in their private arrangements. This double dimension of 'coercion' and 'freedom' is crucial to understand the ways through which the institutions operate and mold the behavior of the agents.

When implementing new environments, some institutions open new fields of activity where the agents will be capable of developing their abilities. Many key economic institutions have to be analyzed in the perspective of creating new activities. And these types of 'constituting rules' create new positions and new types of behavior (CORIAT & WEINSTEIN, 2004). For example, the incorporation of the environmentalist guideline went from an almost complete heresy to the condition of dominant strategic paradigm in the chemical and petrochemical industries, and that was so as a reflection of activist manifestations and changes in the pertinent legislations (HOFFMAN, 2001).

Nelson and Winter (1982) state that the organizations make use of 'routines' that are developed and susceptible to alteration, however in gradual form, adapting to changes in the existing conditions. In other words, the routines have to be endowed with some permanence and stability, which does not mean necessarily rigidity – equivalent to the relative stability of a genome. In such a way, the actions that show results tend to be incorporated in the form of new routines – which would correspond to advantageous mutations, incorporated to the genome as adaptation advantages.

Newman (2000) observes that, in certain occasions, changes in the institutional plain have direct impact in the process of routines internalization. However, this process of learning and adaptation is frequently slow and gradual, since new abilities are difficult to create and cost worthy to modify, over all the ones related to the old 'behaviors'.

3.1. A systemic approach

An important contribution of the institutionalist approach of the innovation process is to clearly indicate the existence of national trajectories of innovation, which are widely determined by the social context in which various agents operate. Firms have prominent roles, but they are embedded, deeply rooted, in a broader context.

Neoschumpeterian economists Freeman (1988) and Lundvall (1992) developed the concept of 'innovation systems' to explain different competitiveness degrees of economies, especially for the technological competitiveness and the abilities to innovate. The National System of Innovation (NIS) comprehends all the actors and institutions involved in scientific and technological activities, which contribute to the development, introduction, diffusion and use of innovations. It includes, of course, the firms, but also the university system, research centers, laboratories of R&D and other agents of the public and private sectors, not necessarily explicitly related to science and technology. The NISs are based on the idea that many of the factors that influence the innovation activities are national. At the same time, it is also clear that the innovation processes are, in many ways, international, therefore technologies and knowledge circulate between borders, local companies interact with foreign companies and universities. Moreover, many markets, in terms of companies and it's the competition processes, are global.

It is possible to *split* the National System of Innovation in different sectors, because the characteristics of the technological progress and the flow of scientific information varies considerably across industries (PAVITT, 1984). The innovation processes vary from sector to sector in terms of development, rate of technological change, interactions and knowledge access, as well as in terms of organizational structures and institutional factors. Thus, Sectoral Systems of Innovation (SSI) emerge, formed by heterogeneous groups of agents who interact to generate, adopt and use technologies – novel or mature – and for the creation, production and use of products pertinent to each of the sectors in question (NELSON, 2006). To support the existence of SSIs is equivalent to recognize that the national and regional borders can vary and that almost always in accordance with the analyzed sector. The idea is to complement the notion of SNI, delimited in its strict direction by national borders (MALERBA, 2003).

The Brazilian's Patent Law and the Generic Medicine Law are like what Malerba (1999) defines as the two ways by which the institutions affect the sectoral system. The first is equivalent to a national institution that has different effects across the sector, depending of the features of technology and knowledge. The last is a sectoral institution which sectoral circumscribed implications

4. The Brazilian Pharmaceutical System of Innovation

Despite the force and the scientific and technological capacity of the main companies of the sector, the pharmaceutical system of innovation depends crucially on elements placed beyond the company borders.

The pharmaceutical industry is a very interesting case of sectoral system of innovation. It encompasses an ample variety of actors involved with research, production, consumption and regulation – companies, universities, public and private research institutions, financial institutions, regulatory authorities, consumers and hospitals (McKELVEY & ORSENIGO, 2001). Note that firms have a crucial hole in this system, but it goes well beyond them. Different countries have different pharmaceutical systems; and there are countries which do not even possess a pharmaceutical industry. In Brazil, however, the sectoral system of innovation reveals an important inconsistency between an active and strong public policy for health (with universal access and coverage) and very important fragilities in the industrial structures, mainly those related to the links along the innovative chain. Firms are an important part of this fragility.

In this section will be presented a sectoral analysis based on the historical-institutional evolution of the Brazilian pharmaceutical industry starting at the decade of 1970 and in the activities done by some pharmaceutical laboratories in the period of 2000-2007.

4.1. An environment without patent protection and with import restriction

Foreign companies dominate the Brazilian pharmaceutical industry. In 1900, the participation of the foreign companies in the national market was of 2.1%, and struck 87.7% in 1980 (VALENTIM, 2003), a gradual conquer that gained momentum during the 1950s and the 1960s, in the midst of nationalist reactions and political turmoil. Different policies, aiming, mainly, the internal development of the industry and the reduction of external dependence, were established. They were supposed to extend the population's access to medicines. With this intent, was promulgated the Industrial Propriety Code ("Código de Propriedade Industrial", by law 5.772, of 21.12.1971), preventing recognition of patents for pharmaceutical3 products, a measure intended to facilitate production and learning – at least, the ability to learn production of substances (active principles) and their "assemblies". As one could not know at that moment, but we all now sadly recognize, the patents exemption could be required, but was absolutely insufficient to provide learning and developing capabilities. Having a large domestic market to develop their entrepreneurial strategies, most firms preferred to set very well developed marketing policies. Uneven income distribution creates at least three different markets – rich

consumers, poor consumers and public sector purchases. They were all large enough to fulfill most competition possibilities and to offer every firm some room. Income distribution and the relation it holds with competition and industrial dynamics should be taken into account if we intend to understand the differences between national cases such as Brazil and India, or USA and Japan. (*See Tables A1, A2 and A3 in the Annex*).

Until the end of the 80s, the direct control of prices by the Brazilian government in diverse sectors had a privileged place as an instrument of market organization and the orientation and articulation of the firms´ strategies. The domestic pharmaceutical industry did not escape this rule, having, during the years of 1970 and 1980, its prices susceptible to direct control regimes, established by the Federal Government by means of the Inter-ministry Council for Prices ("Conselho Interministerial de Preços"). This regulation meant to limit the price of medicines to certain levels, compatible with the Brazilian reality, so that the readjustments were, during great part of the time, below inflation[4] (ROMANO & BERNARDO, 2001).

The decade of 1980 was extremely turbulent for the Brazilian economy. Due to external crisis and to the scarcity of foreign currency, the government opted for the massive restriction of importations as a mean to alleviate the external constraints. The Act number 4, of 1984, took these restrictions to the pharmaceutical industry. The Federal Government established a *market reserve* for the pharmaceuticals that could be locally manufactured, forbidding imports and – this should be kept in mind – preventing competing projects, and so assuring mitigated competition. With the reduction of imports, stimulating vertical integration and diminishing the degree of external dependence related to the first stages of the pharmaceuticals chain (QUEIROZ & GONZÁLEZ, 2001).

These measures intended to create conditions for the local pharmaceutical industry to engage in a process of technological upgrading in order to reach self-sufficiency in terms of production and, at a second moment, hypothetically, the ability to innovate. However, the local industry – both indigenous and foreign – was favored by market protection; and local firms were also favored by the reduction of costs, allowed by the patent withdrawal, simply to increase its profits, and not to make the investment in R&D that the State expected (QUEIROZ, 1993).

While Brazil did not recognize pharmaceutical patents for products and processes, there was a growth of the 'similar medicines'[5] category. The companies had enough margin to carry out considerable investments in marketing, creating differentiation for the trademark of their products.

Frenkel (2001) defines two important characteristics of the medicines that differentiate them from other products and that, in the specific context of the Brazilian pharmaceutical industry, favored the predominance of the commercial logic front to the technological logic: i) the consumer is not

capable of evaluating diverse aspects of the quality of medicines, making it necessary for a specialized professional to certify it; and ii) even the demand for medicines depending on the patients, it is the doctors who prescribe them. In the absence of a recognized public certification trustworthy to the consumers, the reputation of the brand tends to be a key component in the determination of the purchase decisions. And the domestic laboratories possess an expressive number of sales representatives, responsible for using these characteristics to give a boost to their brands and, consequently, to create differentiation between products with similar or identical chemical substances. This practice created a kind of market reserve for their products, what, in turn, translated into extended profit margins.

From the moment the commercial logic predominated over the technical-scientific logic, even if the latter should always be well anchored in the production and marketing assets, the de-linking between the actors and institutions that compose the innovation system becomes latent. The pharmaceutical firms and their laboratories should be the epicenter of innovation activities, but the institutional environment of Brazilian sectoral system was not capable of creating stimulations that made these actors demand technical-scientific inputs, as well as structuring strong and supported linkages between the remaining links of the innovation chain. The environment that public policies created to increase autonomy, development and learning failed to accomplish those goals; but facilitated firms structuring and a certain level of profitability. Price controls reinforced the logic of pursuing commodities and avoiding innovation.

The Brazilian Science and Technology (S&T) System begun to strengthen at the 1930's, with the built of the Universidade de São Paulo, based on the Humboldtian values that merge research and teaching. The creation of the National Counsel of Technological and Scientific Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq) and of the Coordination for Improvement of Higher-Level Manpower (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – CAPES), at 1951, promoted a qualitative and quantitative leap in the Brazilian potential formation of human resources to attend the scientific and technological social needs. Another point that to be worthy of credit is the existence of a diversity of Public Research Institutes, notably in the agriculture sector – with the Campinas's Agronomic Institute (IAC) and the Brazilian Enterprise of Agropecuary Research (Embrapa), for example – and in the aerospace sector – with the National Spatial Research Institute (INPE) and the Aeronautics Technological Institute (ITA). Those institutes were the responsible by the good Brazilian international performance in those sectors. The birth of the Embraer, one of the Brazilian most successful enterprises in technological terms, is quite associated with the ITA's constitution. However, this model, in general terms, presented most successful at the

scientific production than at technological development terms. A possible explanation for that disconnection resides on the Brazilian industrialization model, which demanded few inputs for the local science and technology system.

4.2. A set of institutional changes…

The economic-institutional space of the health sector passed through deep transformations in Brazil, following, belatedly, the trend of most developed countries (GADELHA, 2003). Throughout the decade of 1990, several factors reflected on the behavior of the domestic pharmaceutical sector: we can detach the commercial and financial opening (1988-1993); the liberalization of prices (1991-1992); the launching of the macroeconomic stabilization plan (the Real, in 1993); the approval of the Patents Law ("Lei de Propriedade Industrial Brasileira", in 1996); the creation of the generic medicine category (1999); the creation of the FDA-like "Agência Nacional de Vigilância Sanitária" (ANVISA) (1999) and the retake of the direct control on the prices of pharmaceuticals (2000).

The process of easing import restrictions rendered difficult the growth and consolidation of the domestic production of active pharmaceutical ingredients (API). Additionally, in the decade of 1990, the increase of the finished medicine importations was of 1.304% and that of API intermediate pharmaceuticals, of 204% (QUEIROZ & GONZA'LES, 2001). (*See Tables A4, A5, A6 and A7 in the Annex*).

After a long period of direct control exerted by the Inter-ministry Council for Prices, the pharmaceutical industry, at the beginning of the decade of 1990, started a period of free prices, including all the raw materials and all the pharmaceutical products for human use. The "Real Plan" contributed to changes in the structure and expectations about the potential of the Brazilian pharmaceutical market: on the one hand, the economic stability provided an increase of the units sold and generated an income-effect; and on the other hand, the exchange overvaluation strengthened the picture of the imports growth. (*See Table A8 and A9 in the Annex*).

The liberalization of prices added to the market increase resulting from the new macroeconomic stability, positively modified the dynamics of the sector at the beginning of the decade, for it allowed the companies to regain the profit margin that was uneven since the 80s, a reflect of the elevated inflation rates of the Brazilian economy. The recovery of the margins and the resetting of the prices made it possible for companies to capitalize and invest, once the return perspectives increased.

However, the high readjustments of prices drove the government to reinstate, in 2000, the price control, led by the Chamber for Regulation on Pharmaceuticals ("Câmara de Regulação do Mercado de

Medicamentos" – CMED), made up by several ministries, including Health, Finance, Industry and last but not least Justice. Since then, the readjustment calculations occur once a year and take in account the consumer price indexes, the productivity gains of the companies and the price variations between and within sectors.

Even if the price control rolled by Federal Government, actually the Brazilian medicines consumption, in units, are practically at the same level of 1997, although, in values, has growth three times in Reais and two times in Dollars. (*See Table A10 in the Annex*).

4.3. … and the emergency of a new competitive environment

The Patents Law and the Generics Law were central in the unleashing of an ample and important set of changes in all the dimensions of the pharmaceutical industry and its competitive dynamics. These changes had accented impacts in the internal routines of the firms installed in Brazil, over all the locally-owned, domestic ones.

In 1996, the Federal Government approved the Law 9,279/96, related to patents, fully operating in 1997 – because Brazil resigned voluntarily to the adaptation period permitted by the TRIPS agreement, signed in 1994. With this, new rules of patent property rights protection had been instituted, also to the pharmaceutical products. Since the launching of the Uruguay Round of GATT, intellectual propriety rights were forced into the negotiations, even if they were not directly related to the matter and they had an international organism in charge (WIPO). In this subject, most developed countries followed gracefully the leadership of the USA; and the shared vision of the "rich" became more and more part of mainstream, liberal followers in Brazil.

Being completely insufficient to determine learning and capabilities development, patents exemption was undermined also among several other formed allies. From the moment pharmaceutical patents for products and processes started to be recognized on, it turned out to be impracticable to copy products that are still in the period of protection. And because Brazil voluntarily renounced to the five years grace period, domestic firms had to adapt fast. From then on, there was a growth of the investments in the improvement of the operational infrastructure, expansion of the firms' industrial park and in the incorporation of new technologies. It's appropriate to highlight that this change of position was fruit, in great measure, of the conjugation of this new legislation concerning Patents with the Generics Law. The new institutional elements made frail the competitive strategy of the companies who had constructed its market positions based mainly – if not exclusively – on commercial assets, as

trademarks and channels of distribution established by the relationship of companies with the medical class, the managers of the health system as well as drugstores and retailers.

The Generics Law ("Lei do Medicamento Genérico", Law 9,787/99) was created as an attempt to expand the accessibility to medicines in Brazil, being seen as a chance of growth by some of the domestic companies. The main difference between the generics and the alikes dwell in the requirement of tests for bioequivalence and relative bioavailability, necessary for the registration of the first[6].

The increasing participation of generic medicines disrupted the competition pattern of the pharmaceutical industry, shifting if from the commercial logic to the couple price and quality. Generics are supposed to be perfect substitutes for trademark medicines, including those originally created by the firms who discovered them by means of original research and associated efforts. They do not carry the high costs of R&D and their commercialization requires substantially lower expenses with marketing, because they are medications whose therapeutical qualities are already known and proven by agencies and specialized methods. As consequence, they arrive at lower prices to the consumers then trademark medications.

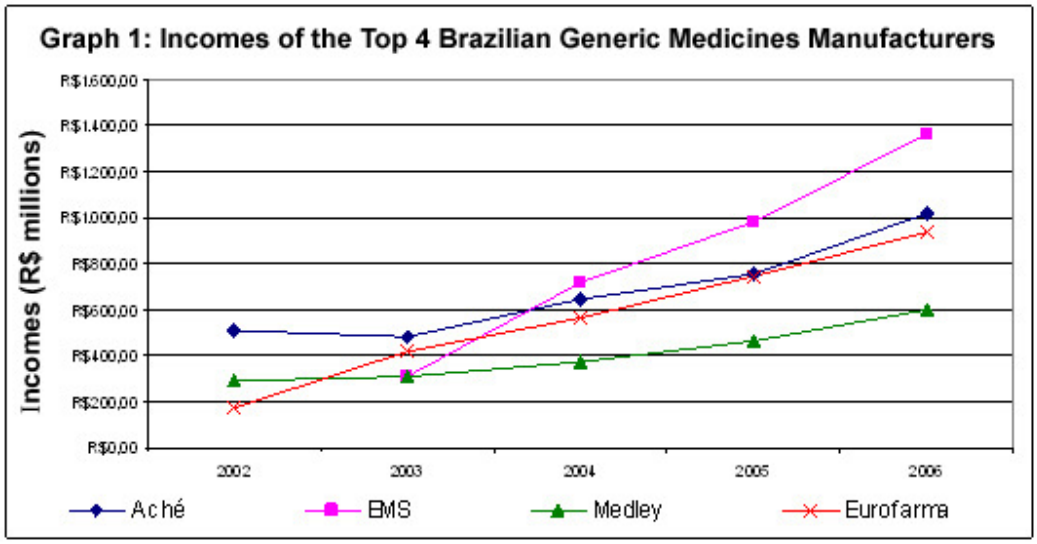
The regulation of generic medicines made impracticable the strategy of concentrating all efforts on commercial assets, once these products do not possess fantasy name and must be put into sale only by the name of the active ingredient. This provoked an important change of the commercial strategies of companies: those firms that produce branded medicines (innovative or similar) spread their products to doctors, while the generic ones are promoted in drugstores and, when using the traditional ways (such as sales representatives), they emphasize the laboratory's name (FRENKEL, 2001).

4.3.1. The consolidation of generic medicines

Beyond the intensification of competition and the treatments' cost reduction, the entrance of generic medicines led to structural changes in the industry, with emphasis to the increased participation of some domestic companies. According to Pro-Generic Organization (2006), the four main companies of the segment are domestically owned – EMS Sigma Pharma, Medley Pharmaceutical Industry, Aché Laboratories and Eurofarma Laboratories. By capital origin, 74.6% of sales in the Brazilian generics market are made by domestic companies.

The good performance in the generics' class has stimulated the participation of the domestic laboratories in the total sales of the industry. In 2006 the Brazilian laboratories' share was of approximately 43%. Leaning on the generic medicine commercialization, the main domestic companies have grown in terms of sales (Graph 1). The only exception to this rule came from the leading company

within the group of domestic firms, too confident over its leadership to seize the opportunity offered by generics and even to appraise their potential effects. In 2000, almost forty years after its foundation, Aché presented the first red numbers in its history and started a process of organizational restructuring. This process involved, in 2005, the acquisition of one of the main generic medicine producers – Biosintética. *If you can not beat them, join them.*



The Federal Government made huge efforts to put into effect the generics, with broad advertising campaigns broadcasted both in radio and television networks. According to Nishijima (2003), the State, through the requirement of the bioequivalence test, pointed to the market that the generic medicine stands as a high quality product. Moreover, the government investments on advertising of generics acted in similar way to those of the pharmaceutical companies with marketing. These factors were crucial to the enhancement of generics in the Brazilian pharmaceutical market.

The generic medicines and the related policy modified the structure of the Brazilian pharmaceutical sector. In recent years, the local market awoke to the interest of foreign companies operating in the generics segment (Table 1). These companies, generally, buy raw materials from the matrix and/or international suppliers.

Table 1: Foreigner laboratories main entries in the Brazilian generic medicines segment

Laboratorie	Capital origin	Entry year	Was the company already installed in Brazil?
Sandoz (Novartis)	Switzerland	2001	Yes
Hexal	Germany	2001	No
Merckle-Ratiopharm	Germany	2002	No
Apotex	Canada	2002	No
Ranbaxy	India	2001	No
Hetero Drugs	India	2001	No
Cinfa	Spain	2002	No
Merck	Germany	2002	Yes

Source: Own elaboration based on information obtained from secondary sources

The domestic firms took advantage of the favorable environment to invest in new production units and the modernization of existing ones. Table 2 exemplifies investments done by indigenous companies, beyond showing an attention to the external market and the adequacy of the plants to the international requirements. To have access to these demanding markets, the Brazilian companies had to adapt to the respective local legislations that discipline the production and sale of generics. This includes remaking the formulations, approving the products and certificating the Brazilian plants in the sanitary control agencies of the United States and the European Union.

Table 2: Some examples of investiments of the Brazilian pharmaceutical laboratories (2000-2006)

Laboratory	Main Investment	Aims
Laboratório Teuto Brasileiro	Ampliation and modernization of the Anapolis's Industrial Park	- To increase the production capacity at three times - Maximize the export's logistic - To attend the FDA's attempts
EMS Sigma-Pharma	New facility at Hortolandia's Industrial Complex	- To increase the generic medicines production at six times - To growth in the domestic market and increase the exports - To attend the FDA's attempts
Laboratórios Eurofarma	Constrution of a new Industrial Complex	- To increase the production capacity - To increase the exports - To attend the EMEA's attempts

Source: Own elaboration based on information obtained from secondary sources

It is quite different to supply medicines to less developed countries, predominant exportations markets of the domestic laboratories until here, where there isn't an established industry, and the most developed, in which the competition is much more intense and has also different focus and scope. To penetrate with the generics in the first group of countries appears as an alternative to obtain scale economies, important because of the low profit margins of generic products. To sell medicine

manufactured in Brazil in consolidated markets such as U.S.A. and Europe can very be important for the growth and the consolidation of the domestic companies, but the challenges are far beyond given possibilities.

The exportation of generic also is associated with research activities. To have a say in the international generics market, low costs are not enough . It is necessary to invest in research capable of resulting in medicines that, using different synthesis routes and different formulations, having bioequivalent clinical results, avoiding being simple copies of reference medicines.

4.3.2. Induced efforts of innovation for the institutional changes

As presented previously, when the strategy based in commercial efforts lost its momentum, the new regulatory landmark induced the local companies to include the technological capabilities and innovation in its strategic guideline. This new scene appeared as favorable to a larger interaction between actors of the Brazilian Pharmaceutical System of Innovation who had typically a more discrete performance. It marked the ascension of the universities, that historically had qualified staff and technical-scientific knowledge relevant to the pharmaceutical sector, but were little explored by local firms. A greater approach between research institutions and the industry has been observed recently, besides governmental and institutional actions in the course of successful innovative efforts. In the following paragraphs examples of this strategic positioning of the Brazilian pharmaceutical laboratories will be illustrated.

In 2000, the São Paulo State Foundation for Science Promotion (Fundação de Amparo à Pesquisa do Estado de São Paulo , FAPESP) launched ten "Centros de Pesquisa, Inovação e Difusão" (CEPID). In the pharmaceutical area, deserves highlight the Center for Applied Toxicology ("Centro de Toxinologia Aplicada", CAT), of the Butantan Institute. The objective of the CAT is to develop research on animals' and microorganisms' toxins, studying their properties to identify molecules that could be explored by the pharmaceutical industry in the creation of pharmaceuticals. The CAT congregates the abilities of the Butantan Institute, together with several research groups of the most important public universities. The projects developed since already generated patents registered in Brazil, U.S.A., Japan and the European Union. Amongst them, is a distinguished one deposited, in 2001, in the Brazilian Patent Office ("Instituto Nacional de Propriedade Industrial", INPI) referring to Evasin, an innovative drug with anti-hypertensive properties developed by the CAT from the *jararaca* (Bothrops Viperidae) poison. This project is carried out in a joint venture with the "*Consórcio Farmacêutico Nacional*" (COINFAR). Another high priority project concerns a protein analgesic

power called Enpak, obtained from the rattlesnake poison. It is an analgesic that has shown itself very powerful and, so far, did not present serious collateral effect. Also it is developed in partnership with the Coinfar.

The Coinfar was born from an initiative of the Government of the State of São Paulo and FAPESP to try to generate local technologies from Brazilian biodiversity. It is a R&D joint-venture – which also acts in the consortia form – formed by three Brazilian pharmaceutical laboratories: Biolab-Sanus, União Química (both belonging to the Castro Marques Group) and Biosintética (Aché). The initiative has the objective of operating as a technological and business-oriented platform for the companies that are part of it, developing projects of new chemical entities in therapeutical classes of international potential. However, its stake-holders stress that it faces several different difficulties and obstacles to increase the investments, to access capital for risky activities , in projects management in all phases, in the absorption of other technological projects, the internalization of R&D activities and, last but not least, the execution of pre-clinical trials in Brazil.

The laboratories of the Coinfar also carry on parallel projects of research. In 2005, the Biosintética had a financing approved by the National Development Bank ("Banco Nacional de Desenvolvimento Econômico e Social", BNDES) within Profarma[7]. The operation had the objective of expanding its R&D activities on new products and inputs for the pharmaceutical industry, over all in the dermatological line, in partnership with the PIC Chemical, which acts in the raw material segment for cosmetics, pharmaceuticals, nutritionals and phitotherapics. Biosintética stood out in the national scene for possessing about thirty patents in the international market. Also deserves emphasis the project to develop a line of products from Brazilian plants, through investments in university, and credit from the Brazilian Innovation Agency ("Financiadora de Estudos e Projetos", FINEP) to extend its researches.

Aché, the larger domestic pharmaceutical company, concentrates its efforts in R&D of its generics and prescription drugs in the biotechnology area, fortifying the endeavor that was lead by the Biosintética. The declared objective is to develop the studies that associate two or more molecules of already known drugs, called fixed associations. Between 1993 and 2003, the company developed four products from intelligent associations of different active ingredients in the same medicine. This type of innovation is important for the company, in first place, because it represents an income source that helps to support other innovation projects of higher risk. And, in second place, because it involves critical knowledge and the incremental innovations are important for the accumulation of competences. But it illustrates also the powerlessness of the company's technological efforts.

In 2005, the Aché launched the anti-inflammatory Acheflan, a phytotherapic developed from the popular knowledge, with 100% national technology. The Acheflan passed through all the phases of scientific proof that a drug with a synthetic active ingredient must carry out. The studies for the development of the product took seven years and were lead in association with the Federal University of Santa Catarina (UFSC), with Unifesp, PUC-Campinas and the State University of Campinas (UNICAMP). Currently, the product is leader in the segment of dermal anti-inflammatories under medical prescription and presents good profit margins. Only the future will say if the success of this product is related more its therapeutic virtues or to the undeniable qualities of the company's commercial assets, including a very well developed network with doctors and drugstores.

The Biolab laboratory appealed to the BNDES for R&D financing. The intake was destined to support topic research of thirteen medicines, the creation of two new forms of presentation and the construction a semi-industrial plant for the development of new formulations. About the development of new products, Biolab-Sanus presented an innovative medicine for prophylaxis of Riots of the Closing of the Neural Pipe during the pregnancy, an illness that afflicts several thousand of babies each year, only in Brazil. Currently, the main treatment is with a combination of two medicines and the cost is about 2/3 of Brazilian minimum wage during the pregnancy. The company, requested from health autorithies (CMED) a price which is below the present cost of the treatment, while well above the production cost. The company argues that the new treatment would save more than R$ 6 millions each year for the public health system. The resolutions of CMED were conceived within a rather different context, to attend the necessity of the State for always cheaper medicines, not that of the innovative firms; that is why prices are linked to production costs, without R&D costs and innovation premium. The solution that the laboratory found to overcome the problem was to commercialize the product overseas and to import it back to Brazil, for the same price as the international market. There is, thus, a disarticulation between the Industrial Policy and the Health Policy of the Federal Government. But one could say that both, health and industrial policies, are still entrenched on the old fashioned way of thinking, even if both declare their engagement towards innovation.

Biolab-Sanus, another local firm, in association with Eurofarma, also local, constituted Incrementha RD&I, a company for the development of new technological products and platforms, focusing projects of incremental innovation. The model adopted by Incrementha intends to internalize the abilities in regulation, patents, research and elaboration of protocols in clinical research. The team is formed by a doctor and twenty other employees specialized in key-areas for the development of new pharmaceutical products, such as marketing, patenting, regulatory, commercial evaluation, pharmo-analysis development and clinical research. The lines of R&D count on the contribution of universities

and involve new combinations of already known drugs, new formulation of already known drugs and new molecules chemically related to existing drugs.

Eurofarma is also involved in other projects. The company directs efforts to radical and incremental innovations, with the universities and research institutes playing an important role in the innovation process. About twelve researchers holding master and PhD grades currently work in the company in the areas of RD&I, with emphasis to the areas of biotechnology, molecular biology and pharmacology. The objective of Eurofarma is to go beyond the manufacturing of generics, and advance in more complex segments of the pharmaceutical industry. Also with partnerships withseveral different universities, the company intends to discover innovative products. Moreover, the company research team and their partners within the universities investigate on the Brazilian biodiversity to identify phytotherapic products and, by means of a technology transfer agreement with the American DevaTal, entered in the biotechnology area, counting on a pilot plant.The main project, amongst several on phytoterapics, refers to an oral product, with analgesic and anti-inflammatory action, obtained from the dry leaf extract of the *Aleurites moluccana* species. This project was initiated in 2001, in association with a research group from the University and, in 2007, the company applied for the patent on the extract.

The domestic company Cristália is perhaps a distinguished case in terms of R&D activities and related industrial capabilities. This company stands out in the national scenario because it auto-supplies about 1/3 of the active principles used to produce its products –about 60 different molecules – an extraordinary fact in the pharmaceutical industry installed in the country – both local and foreign owned. Cristália received, recently, financial support from FINEP to internalize the production of pharmaceuticals. The company also established alliances with domestic research institutions, such as USP, state laboratory Far-Manguinhos, Institute of Technology in Pharmaceuticals, the Foundation Oswaldo Cruz, UFRJ, UFMG, Unicamp, Butantan Institute, amongst others. In 2004, Cristália received a patent from the *United States Patent and Trade-Mark Office* (USPTO), the North American official agency of industrial property registration, for the discovery of a new active ingredient when using an innovative technology to transform one old substance into an anesthetic and analgesic, with reduced collateral effect for patients. In 2006, Cristália received the patent for a compound for erectile dysfunction, from the USPTO. The product was launched in the market in 2007 and took six years to be developed, counting on financial support from FINEP and BNDES. Cristália engaged fifteen national research centers and universities to carry out the required clinical studies for the approval of the medicine. In 2007, the company licensed five patents from Unicamp, in the scope of the Innovation Law and had two projects approved in the economic subvention program, under the main subject

pharmaceuticals and medicines with focus in AIDS and hepatitis, one the main headings of the Subvention Program recently set up by federal government. The company R&D activities are developed by a team of about fifty people, including eight PhD holders, ten holding master´s degree and about thirty specialists.

Chemical company Nortec is probably one exception in terms of the production of pharmaceutical active ingredients. With about 200 customers in Brazil abroad, it possesses the largest line of pharmaceuticals in Brazil, with 43 active ingredients being produced (and in the market) and 31 more being development.

Current leader of sales of the Brazilian pharmaceutical industry, the Group EMS-Sigma Pharma, set up the Research and Development Center, for the development of its formulations and tests of validation and stability in laboratorial and semi-industrial scale, counting, according to company, with about 200 people. It also works on analytical methods of equivalence and of new pharmaceutical presentations. In 2006, the group announced a partnership with the Italian company MonteResearch, specialized in pharmaceutical R&D. The objective of the agreement is to make the joint development of new pharmaceutical formulations. The companies began, in Brazil, to develop a clinical study with a new medicine against vaginal infections caused by fungus and bacteria.

The examples presented here seem to point to an inflection of the strategy of the domestic industry when it comes to R&D activities. The investments in R&D by the industry were multiplied by more than 10 times between 1994 and 2003, from R$ 12.3 million to R$ 153 million in the period (REVISTA DA INDÚSTRIA FARMACÊUTICA, 2005). The culture of the clinical research is still in the initial phase of creation in the country and the domestic companies are only now becoming conscious about the importance of the pharmaceutical research.

From the alternatives available to the domestic laboratories, stand out the incremental and phytotherapic research, which demand lower financial intakes and allow faster returns. The domestic segment of the industry may not yet have the required abilities to make innovative substances in large scale, but it can invest in incremental innovations and make *me-too' s*[8] (case of the medicine for erectile malfunction of the Cristália Laboratory), to formulate fixed associations, and to find second uses for existing drugs. The understanding of the meanings of these innovations is subject to multiple understandings, but perhaps the most consistent interpretation shows that it is not a second category innovation, but innovation inside of a well established technological trajectory. It is perhaps the possible entry into a long neglected dimension of the pharmaceutical industry in Brazil.

The delay of Brazil in this field is immense and requires, for its overcoming, a selective approach with regard to the niches in which it is possible to act. The Brazilian biodiversity represents –

according to many analysts – a great potential for radical innovations. But biodiversity is not enough to create innovative drugs; which depend heavily on new investments and broad and deep scientific knowledge.

A second field refers to generic medicines of great interest to public health. Perhaps one of the main questions related to this matter relates to public choices in terms of costs versus effectiveness, and short term versus long term views. Some of the programs on public (universal) health, provided forcefully by the Constitution text approved in 1988, are expensive and depend heavily on choosing the first term in both pairs. Providing healthcare for every citizen is certainly the right thing to do, but once we admit that resources are scarce, it reduces the field of action.

It is difficult to imagine that a new pharmaceutical industry can appear suddenly, after decades of performance based on copyist and lazy strategies, at least of the main – and most successful – protagonists. There are, however, diverse evidences that important changes are on the way. They seem to illustrate the process of sprouting and conformation of strategies capable of guaranteeing a certain capacity of innovation - even in incremental terms - to the domestic pharmaceutical industry. In short, one admits that the process in course is relevant mainly from the point of view of the trend that it can represent, where the modesty of the developed activities and the strong dependence with regard to the university research.

5. Discussion and concluding remarks

Brazil has traditionally been one of the largest pharmaceutical markets of the world (among the top ten), attracted investments from a whole bunch of multinational corporations, was able to develop scientific capabilities in the relevant areas of knowledge to conduct apparently quality research, it is supposed to have create also original discoveries – but it never achieved a drug discovery to move forward from the scientific discovery to the market. It is certainly true that the pharmaceutical industry is not just an industry like others. But conceiving and producing airplanes also cannot be considered an industry like most others, and Brazil possess now the 3rd or 4th largest airplanes manufacturer in the world. Even if the pharmaceutical industry has its own elements to be considered to explain the Brazilian disappointment in this field, the main reasons are certainly to be found elsewhere, and they seem to be mostly related to the Brazilian pharmaceutical system.

The predominant strategy of the local industry until the middle of the 1990s was to copy medicines produced overseas and to acquire a favorable position in the market through massive efforts in marketing. Marketing, within the context of pharmaceuticals, is a quite large and diversified activity,

ranging from actions directed to main hospitals and doctors to tactics towards drugstores and salespeople. And some firms were active and smart enough to get into associations with foreign firms to commercialize their products in Brazil, charging a fee for their commercial assets. On the other hand, in this period, these same firms were not active at all in terms of conducting research of their own neither in cooperative ways, with universities and other public research organizations. The Brazilian Pharmaceutical System of Innovation, if we could define such an entity, was unfinished, immature, and underdeveloped. And the main fragility was not on the scientific side of the equation.

The incorporation of the institutions to the analysis of the Brazilian pharmaceutical sector helps us on the understanding about the changes and the trajectories of development, incorporating social, political, scientific and institutional environments – both past and present. Institutions are capable of molding the action of the agents as well as they are capable of modifying their interactions. The approval both of the Patents Law and the Generic Medicine Law are two important building blocks of the Brazilian Pharmaceutical System of Innovation, and these two pillars are changing substantially the industrial structure and the competition dynamics. More and more, the firms are integrating both elements into their strategies, not only as a restriction, as it was the case of patents just after the approval of the Law, but much more as a constituent part of their actions and trajectories. At first, generics undermined and destabilized the leaders footholds, largely based on commercial assets; but the response was to adhere, even though on a displeased way. The firms which first seized the opportunity – for them immense – were able to jump in first and to build up strong positions based on generics.

But domestic firms can not expect to survive and to growth based only on generics. The arrival of multinational companies producing generics, the limits of the first batch of products without patent protection, the exploration of legal mechanisms to extend the duration of the patents, and the larger complexity of some products – over all new, for which it is difficult to carry out the bioequivalence tests – all these factors limited the space for generics and contributed to diminish the performance of companies relying only on that family of products. Adding the fact that they are products with lower profit margins, it results that the survival of the manufacturers of generics in the medium run is far from assured. That is why companies' perception was to give another, different step further.

However, the adaptation and learning processes era slow and gradual, for new abilities are difficult to create and hard to modify. And this applies to a great extent to 'old', deeply rooted behaviors. It is obvious that the strategy to direct efforts to RD&I it is far from unanimous among the sector firms. There is still a considerable reluctance on the part of the companies' stakeholders concerning a much more intense enrollment in such activities, full of uncertainties and risks. And the

short-term views, typically present on the old strategies, still contaminate the new ones, making technological choices much more restricted than they could otherwise be.

It is possible to see both strategic alternatives – generic medicines and innovative products – as complementary. If we consider the hypothesis that the great expense in R&D is proportional to the cash flow of previous periods, the success domestic firms are getting with the generics will make them able to strengthen their financial muscles, adding to their R&D investments. Evidences exist, even if incipient, to confirm preliminarily this assertive. Additionally, as the companies strengthen their links with the innovation systems, they reinforce their qualifications in terms of R&D, openning the possibility of partnerships arrangements with universities, local and foreign companies, and research institutes – both public and private. Some examples pointed out here show the importance of partnerships for innovation in the pharmaceutical sector, for most domestic pharmaceutical companies simply did not had, until very recently, the means to conduct research on their own. They can rely on universities and PROs for that goal, but they still have very important limitations, relating to other stages, like clinical and pre-clinical trials or chemical synthesis. Companies abroad, who provide these services and that possess a series of chemical, biochemical, biotechnological and molecular biology expertise, can be assessed to full the gap, but one should perhaps start to recognize that the pharmaceutical industry and its innovation systems still have fissures and discontinuities. The pharmaceutical system of innovation, in Brazil, is still limited.

Adding to the value chain those stages with larger technological content is important to the survival of domestic companies in this segment. Moreover, it can also be an attraction factor for those multinationals companies, in search, for example, for competitive advantages. Such aggregation characterizes itself, therefore, as an essential condition to keep the competitiveness in the new market conditions provoked by the structural changes occurred in Brazil in the recent period. Despite production and innovation being distinct activities, they can be considered interdependent, and therefore the learning process inherent to the production activities represents an important input concerning the innovative activity. Initiatives in the molds of Coinfar, Incrementha, or the strategies of companies such as Cristália and Biolab, the linking between public and private research institutions, university and with federal financial institutions devoted to development, such as BNDES and FINEP, illustrate how the dynamics of all actors, ranging from the firms to academic, financial and regulatory spheres – were deeply modified.

These examples keep alive the hopes for a more qualified domestic pharmaceutical industry and perhaps much more competitive in the international scenario. For such a change to happen it is necessary to go beyond structuring and strengthening the links between the university scientific

capabilities and the firms. As Rosenberg (1990) argued, for the firms to profit from scientific knowledge, they have to develop scientific capabilities of their own. The Brazilian Pharmaceutical System of Innovation has scientific qualification in the universities and has started to develop links – simple and complex – between those institutions and firms, but important fragilities still remain. They concern both public policies and the private sector strategies, still rooted in the old territory defined by import substitution and protection, along with price controls and marketing strategies.

For the actors to exert their innovative potential, it is necessary that the environment favors the technological aspects as compared to the pure commercial logic. This seems to be indispensable for the development of local capacities and for the consolidation of the process that is – as the evidence suggest – in course. Individually, the next stage of development of the Brazilian Pharmaceutical System of Innovation will be the formation and consolidation of research teams internally to the companies or directly tied to its technological, industrial, patent and commercial strategies. The evidences and thoughts presented in this article are not enough to nullify the doubts that still exist about the strength and the effectiveness of this process, but to light up some important aspects and opportunities defined at present. The next years and the directions taken by firms and other members of the SSI should present us more definite elements and allow us to have much more unambiguous answers. Taken the risk of being too optimistic about our possibilities, we could perhaps finally direct our efforts to build-up a pharmaceutical structure and dynamic able to fulfill the best hopes of Brazilians´ health needs.

Notes

[1] The article is mainly based on the monitoring and observation of the activities of the domestic pharmaceutical laboratories. The strategy and behavior of the multinational laboratories possesses a logic defined in another scale and they will not be analyzed. Additionally, the focus of the article concentrates in the firms' strategies and it does not approach the insertion of the neglected illnesses, but the argument is compatible with a strong policy in this direction.

[2] Entity founded in 2001 that congregates the ten main generics industries in the country, corresponding to about 90% of this markets' sales.

[3] truthfully, Brazil did not recognize patents for pharmaceutical products since the Decree Law 7,903, of 27 of August of 1945.

[4]Accumulating imbalances, such as between 1984 and 1989, of 28% (QUEIROZ & GONZA'LES, 2001).

[5] Medicine copies that have propose the same action as the original product, however were not obliged to go through the tests that prove the same therapeutic action.

[6] In 2003, the Anvisa published 19 resolutions, determining the obligation to accomplish these tests for the new similars and those already in the market.

[7] Support Program for the Development of the Pharmaceutical Productive Chain, launched in 2004 and structured to contribute to the implementation of the industrial, technological and foreign commerce policies of the Federal Government.

[8] Are products launched later to the original and that possess molecular structure different enough of to the innovators so not to infringe the patent, but its therapeutic action is similar to the one of the innovative drug.

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ANNEX

Table A1

Brazil - Consumptions of medicines by family (monetary expenses - 1981)

Tipe of expense	Family Income Group by Number of Minimum Wages									
	All groups	Less than 1	Between 1 and 2	Between 2 and 3,5	Between 3,5 and 5	Between 5 and 7	Between 7 and 10	Between 10 and 15	Between 15 and 30	More than 30
Number of families (thousands)	19.134	5.026	4.146	3.841	2.235	1.514	1.106	692	481	94
Expense with medicines	363	63	156	283	414	524	660	782	957	1.147

Source: ENDEF (1981)

Table A2

Brazil - Consumptions of medicines by family (monetary expenses - 2002)

Tipe of expense	Family Income Group by Number of Minimum Wages									
	All groups	Less or equal to 2	Between 2 and 3	Between 3 and 5	Between 5 and 6	Between 6 and 8	Between 8 and 10	Between 10 and 15	Between 15 and 20	Between 20 and 30	More than 30
Number of families (thousands)	41.133	5.540	5.244	8.381	3.128	4.572	3.108	4.298	2.310	2.161	2.392
Expense with medicines	41,08	14,64	21,18	27,65	33,44	39,17	48,09	52,97	64,36	81,16	117,52

Source: POF (2002)

Table A3

Medicine consumption by income group (share - %)

Income group	Share of the Brazilian population	Share of the Brazilian medicines consumption	*Per capta* expenditure with medicines (US$)
More than 10 minimum wages	15,0	48,0	193,40
Between 4 and 10 minimum wages	34,0	36,0	64,15
Less tha 4 minimum wages	51,0	16,0	18,95

Source: MARQUES (2002)

Graph A1

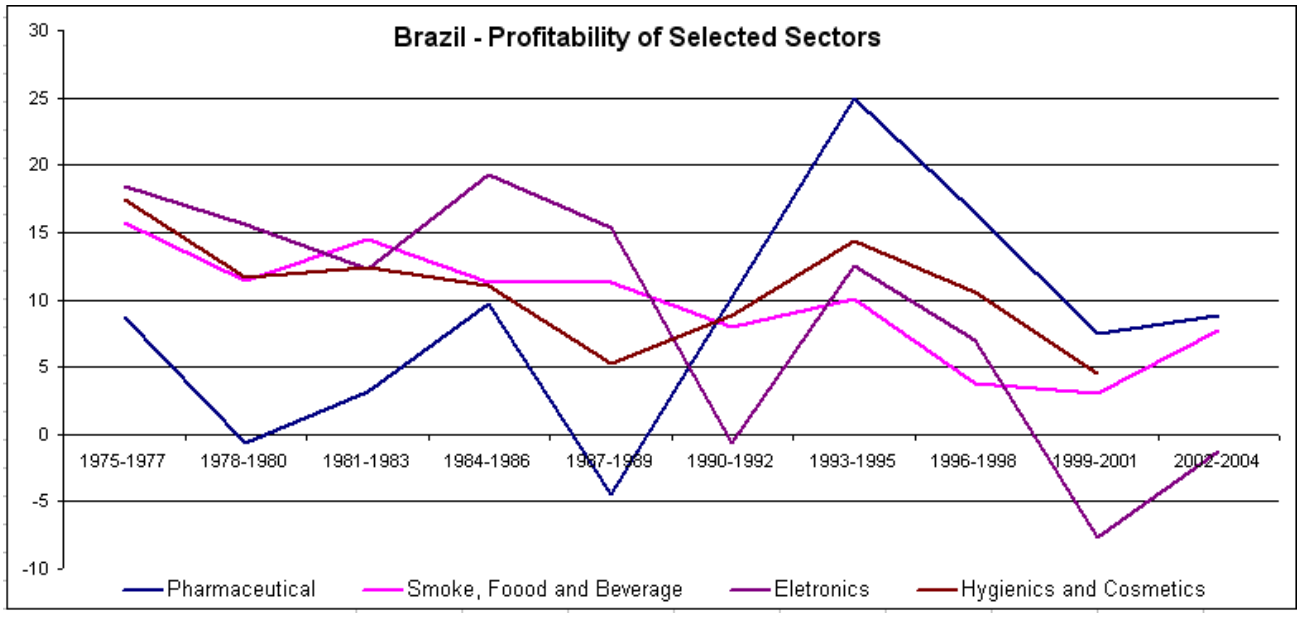

Table A4

Brazilian production of active pharmaceutical ingredients (API) in the 1980s

Year	US$ millions
1982	268
1983	259
1984	297
1985	321
1986	417
1987	521

Source: SDI/GSIII, *apud* Queiroz (1993)

Table A5

Brazil - Pharmaceutical Imports (US$ millions)

Year	API	%	Intermediaries	%	Medicines	%	Total	%
1981	310,7	85,0	37,4	10,2	17,4	6,6	365,5	100,0
1982	277,4	80,6	49,7	14,4	12,4	4,0	344,3	100,0
1983	226,6	75,2	62,6	20,8	12,4	4,0	301,5	100,0
1984	185,7	68,8	73,6	27,2	10,6	4,0	269,9	100,0
1985	200,4	65,1	77,8	26,4	16,1	5,5	294,3	100,0
1986	241,3	63,0	96,5	27,2	17,2	4,8	355,0	100,0
1987	278,3	67,9	115,5	27,9	17,2	4,2	410,0	100,0

Source: SDI/GSIII, *apud* Queiroz (1993)

Table A6

Brazil - Local production, imports and exports of API and Pharmaceutical Intermediaries
US$ million

Ano	Estimated Local Production			Exports			Imports		
	API	PI	T	API	PI	T	API	PI	T
2001	380	96	476	116,5	48,7	165,2	908,80	38,3	947,10
2002	314	81	395	127,0	51,0	178,0	831,60	31,8	863,40
2003	324	88	412	133,1	56,0	189,1	851,80	34,2	886,00
2004	397	96	493	196,2	60,0	256,2	1.042,70	42,3	1.085,00
2005	414	98	512	211,3	62,0	273,3	1.091,70	43,9	1.135,30

API - Active Pharmaceutical Ingredient PI - Pharmaceutical Intermediaries T - Total
Source: CAPANEMA, 2006

Table A7

Brazilian Exports and Imports of Pharmaceutical Products (1997-2007)*

Year	Exports (US$ FOB)	Change (%)	Index: 1997=100	Imports (US$ FOB)	Change (%)	Index: 1997=100	Commercial Déficit	Change (%)	Index: 1997=100
1997	154.306.311	-	100	1.013.759.105	-	100	859.452.794	-	100
1998	195.127.915	26,45%	126,5	1.213.273.638	19,68%	119,7	1.018.145.723	18,46%	118,5
1999	231.559.350	18,67%	150,1	1.512.543.555	24,67%	149,2	1.280.984.205	25,82%	149,0
2000	218.894.714	-5,47%	141,9	1.421.191.691	-6,04%	140,2	1.202.296.977	-6,14%	139,9
2001	241.857.890	10,49%	156,7	1.522.157.755	7,10%	150,1	1.280.299.865	6,49%	149,0
2002	253.917.686	4,99%	164,6	1.527.619.987	0,36%	150,7	1.273.702.301	-0,52%	148,2
2003	280.748.997	10,57%	181,9	1.512.230.888	-1,01%	149,2	1.231.481.891	-3,31%	143,3
2004	352.619.366	25,60%	228,5	1.785.064.690	18,04%	176,1	1.432.445.324	16,32%	166,7
2005	474.494.467	34,56%	307,5	2.037.156.541	14,12%	201,0	1.562.662.074	9,09%	181,8
2006	622.128.690	31,11%	403,2	2.609.454.734	28,09%	257,4	1.987.326.044	27,18%	231,2
2007	745.671.812	19,86%	483,2	3.521.572.029	34,95%	347,4	2.775.900.217	39,68%	323,0

* Only the products of the NCM's Cap. 30
Source MDIC/Secex/Sistema A

Table A8

Brazilian Pharmaceutical Production - End of the 1980s

Year	US$ millions
1985	1,59
1986	1,69
1987	1,97
1988	2,00
1989	2,60

Source: ABIFARMA *apud* Queiroz and Gonzáles (2001)

Table A9

Brazil - Sales of the Pharmaceutical Sector

Year	Units (bilion)	Value (US$ billion)
1992	1,71	3,6
1993	1,62	4,8
1994	1,53	6,2
1995	1,77	8,3
1996	1,82	9,7

Source: ABIFARMA *apud* Queiroz and Gonzáles (2001)

Table A10

Brazilian Pharmaceutical Market (1997-2008)

Year	Nominal Sales (R$ 1.000)	Change %	Index: 1997=100	Nominal Sales (US$ 1.000)	Change %	Index 1997=100	Sales (1.000 Units)	Change %	Index 1997=100
1997	9.210.340	-	100	8.537.436	-	100	1.854.094	-	100
1998	10.064.780	9,28%	109,3	8.660.434	1,44%	101,4	1.814.337	-2,14%	97,9
1999	11.847.533	17,71%	128,6	6.537.763	-24,51%	76,6	1.778.800	-1,96%	95,9
2000	12.281.749	3,67%	133,3	6.705.678	2,57%	78,5	1.697.822	-4,55%	91,6
2001	13.427.727	9,33%	145,8	5.685.430	-15,21%	66,6	1.640.251	-3,39%	88,5
2002	14.985.132	11,60%	162,7	5.210.328	-8,36%	61,0	1.662.190	1,34%	89,6
2003	16.934.356	13,01%	183,9	5.575.005	7,00%	65,3	1.526.720	-8,15%	82,3
2004	20.190.101	19,23%	219,2	6.882.028	23,44%	80,6	1.700.264	11,37%	91,7
2005	23.883.373	18,29%	259,3	9.905.674	43,94%	116,0	1.734.378	2,01%	93,5
2006	25.908.217	8,48%	281,3	11.865.365	19,78%	139,0	1.759.815	1,47%	94,9
2007	28.127.191	8,56%	305,4	14.573.276	22,82%	170,7	1.801.248	2,35%	97,1
2008*	29.846.280	6,11%	324,1	17.432.752	19,62%	204,2	1.811.198	0,55%	97,7

* 12 months (Set/2007 - Ago/2008)
Source: GRUPEMEF