



## **Catching up in the pharmaceutical sector: Lessons from case studies of India, Thailand and Brazil<sup>1</sup>**

*Samira Guennif<sup>2</sup>*  
*Shyama V. Ramani<sup>3</sup>*

### **Introduction**

For most developing countries, the creation of a strong indigenous pharmaceutical industry and an effective national health care system are primary objectives yet to be attained. Since the end of World War II and the ushering in of decolonisation, they have been striving towards these ends through appropriate public investment and policy implementation. Furthermore, medicines and health care services are essential goods which have to be accessible to all. Therefore, catching-up in the pharmaceutical sector cannot be considered uniquely in terms of the development of industrial capabilities, but must be defined as a vector with at least two components: (i) industrial competence and (ii) availability of and accessibility to essential medicines. Industrial capabilities refer to the quantity, quality and variety of pharmaceutical products that are produced within a country to satisfy local and international demand. A national healthcare system refers to the set of organizations, institutions, resources and people within a country, whose primary purpose is to promote good health in accordance with the expectations of the population and against a fair financial contribution (WHO, 2008). Since a little more than a decade the task of healthcare systems to ensure access to medicines has been made more complex by the international homogenisation of intellectual property rights (IPR) regimes. This refers to the signing of the Trade Related Intellectual Property Rights (TRIPS) convention by the member countries of the World Trade Organization (WTO)<sup>4</sup>. In the above context, the present paper focuses on the first component of the catch-up vector and attempts to answer two central questions: What are the determinants of catching up in terms of industrial capabilities in the pharmaceutical sector? What is the role of intellectual property rights on the catching up process? We use the case study method to answer these questions through an examination of the evolution of the pharmaceutical sector in three emerging economies: India, Brazil and Thailand.

---

<sup>1</sup> The sections on India draw largely from the publications of Shyama V. Ramani cited in the references.

<sup>2</sup> CEPN, University of Paris 13, [samira@guennif.com](mailto:samira@guennif.com)

<sup>3</sup> INRA & Ecole Polytechnique, Paris, [shyama\\_ramani@yahoo.com](mailto:shyama_ramani@yahoo.com)

<sup>4</sup> TRIPS, a product of the last round of GATT negotiations, which took eight years to conclude (1986-1994), was initiated by the U.S.A., Europe and Japan. These countries argued that a strong IPR regime is a critical pre-condition for private investment in research and development, and hence economic growth in all countries. At the same time, evidently such a move was designed to increase entry barriers for second innovators from emerging economies, which had begun to claim significant shares in international markets. TRIPS made product and process patent protection mandatory in all branches of manufacturing, including drugs, effectively eliminating the possibility for second innovators in developing countries to produce and sell pharmaceutical products through re-engineering. It also homogenized the period of protection to 20 years and banned discrimination between imported and domestic products.

According to the WHO (2004), the production of medicines is highly concentrated in high-income countries, being 93% in the high income countries and 4.5% in middle income countries and 2.6% in low-income countries and middle-income countries (see figure in appendix). Furthermore, it divides the developing world into four groups in terms of their manufacturing and innovation capabilities. Now, the core component of any drug is the set of 'active pharmaceutical ingredients' or API contained in it. API are then combined and first processed into a 'bulk drug' containing the therapeutic molecule in powder form. Thereafter, it is further processed into a 'formulation' or the final form of the drug in the form of tablets, capsules, syrups, injections and plasters etc. The most advanced in terms of catching-up are countries with manufacturing capacities in both bulk drugs and formulations as well as as nascent innovation capabilities like India and China. Second, there are countries with manufacturing capacity in formulations and competence in the production of bulk drugs, but relying on imports of API to satisfy their demand. Third, there are countries which have only competencies in formulations and packaging of imported products. Finally, there are countries which have no manufacturing capacities and are totally dependent on imports of drugs and these are mainly situated in Africa. The present paper does not consider the last group, but instead tries to understand the process of catching, by studying three different countries in the three categories: India in the first, Brazil in the second and finally Thailand in the third.

The methodology used and subsequent organisation of the paper are as follows. We begin with a comparison of the industrial capabilities of the three countries today, in order to have an idea of how much they have caught-up. Then we examine their R&D and innovation capabilities to gain insight on their potential to catch-up process in the future. Then, we trace the evolution of their IPR regimes in order to try to understand the role of IPR on the development of industrial capabilities. The authors readily admit that a limitation of the paper is its focus on the development of industrial competence without a study of health systems in these countries, or the determinants of their performance. The latter is neglected as it is beyond the scope of the present study. However, even an examination of the first component of the catch-up vector in pharmaceuticals yields some valuable insight on how development can be accelerated and social welfare improved.

## **1. How much catching-up? A comparison of industrial capabilities**

### **1.1. India: Becoming global**

Currently, the Indian pharmaceuticals market ranks 4<sup>th</sup> in volume and 13<sup>th</sup> in value in the world<sup>5</sup>. The value of its production is estimated to be approximately \$4.5 billion<sup>6</sup> and it employs about 5 million workers directly and 24 million workers indirectly. In August 2007, the McKinsey group released the report of a year old study indicating that the Indian pharmaceutical industry could grow to between 16 and \$24 billion by 2015<sup>7</sup>. About 75% of the increase in demand is expected to be generated by population and income growth, development of private and public insurance schemes and improvement in health infrastructure (especially outside of the metropolitan cities). If these projections are realized, India would be among the top ten in terms of market value and among the top three in terms

---

<sup>5</sup> According to Organization of the Pharmaceutical Producers of India (OPPI, 2004)..

<sup>6</sup> <http://www.pharmaceutical-drug-manufacturers.com/pharmaceutical-industry/>.

<sup>7</sup> India Pharma 2015: Unlocking the potential of the Indian pharmaceutical market. [http://www.mckinsey.com/locations/india/mckinseyonindia/pdf/India\\_Pharma\\_2015.pdf](http://www.mckinsey.com/locations/india/mckinseyonindia/pdf/India_Pharma_2015.pdf)

of growth of the pharmaceutical sector by 2015<sup>8</sup>. Currently India also has the largest number of manufacturing units authorized by the Federal Drug Agency of USA outside of the USA: India had 75, Italy 55, Spain 25 and China 27 in 2007<sup>9</sup>.

According to an extremely comprehensive and well analyzed report of the US Trade Commission, the Indian pharmaceutical industry is characterized by “fierce competition and high volumes, razor-thin profit margins, overcapacity and declining prices” (Greene, 2007). The overcapacity is likely to refer to the small scale sector firms, which supply the big firms with bulk drugs and related services and play an important role in holding down prices. There are two types of firms in the Indian pharmaceutical industry: organized sector firms (i.e. registered under the Factories Act, 1948<sup>10</sup>) and informal sector firms. Currently it is estimated that the number of firms in the pharmaceutical sector ranges between 20,000 and 23,000, of which about 3000 are in the organized sector. Of the latter about 90% are small scale firms, i.e. with a capital of less than \$1.25 million.

As in Western markets, the concentration of firms is not high at the aggregate level, but very high in niche therapeutic segments. The share of the top 10 firms in India is about 45%, which is very low as compared to the US where the top 10 firms account about 70% of sales. However, in niches such as streptomycins and chloramphenicols, the concentration is very high, with share of the top 4 firms being 98.6% and 93.1% respectively. There is also geographical concentration. For instance, the two states of Gujarat and Maharashtra account for 40% of the firms and 43% of production. If we take into account two more states Andhra Pradesh and Uttar Pradesh, we cover 60% of the manufacturing units (Pradhan, 2007).

Dutta (2007) points out that nearly 73% of the Indian market is supplied by Indian firms making India the only country in the world besides Japan, which is not dominated by Western multinationals. Currently, 9 of the 10 top manufacturing firms in India are local ones. At the same time, there are approximately 34 foreign drug companies active in the Indian market including 15 of the world’s largest pharmaceutical multinational companies (Greene 2007). GSK-India, a subsidiary of GSK Plc (UK) is the largest foreign pharmaceutical company in India and among the top ten supplying 5.9% of the Indian market.

Eighty percent of the production is in the form of formulations and only 20% remains in bulk drug form. Self-sufficiency is almost total in formulation and mostly achieved in bulk drugs as well (see figure 1). Exports have been growing steadily since 1990. For the three top firms, Dr Reddy’s Laboratory, Ranbaxy and Cipla, export revenues now account for almost half of their total revenues. The main export markets are the USA (which is growing in importance), Russia, Germany, U.K. and China followed by Brazil, Nigeria and Canada and the main products exported are bulk drugs of various kinds, antibiotics, vitamins and vaccines. The imports of pharmaceuticals mainly consist of products imported by foreign multinationals from the mother companies for re-sale in India (Greene, 2007)<sup>11</sup>.

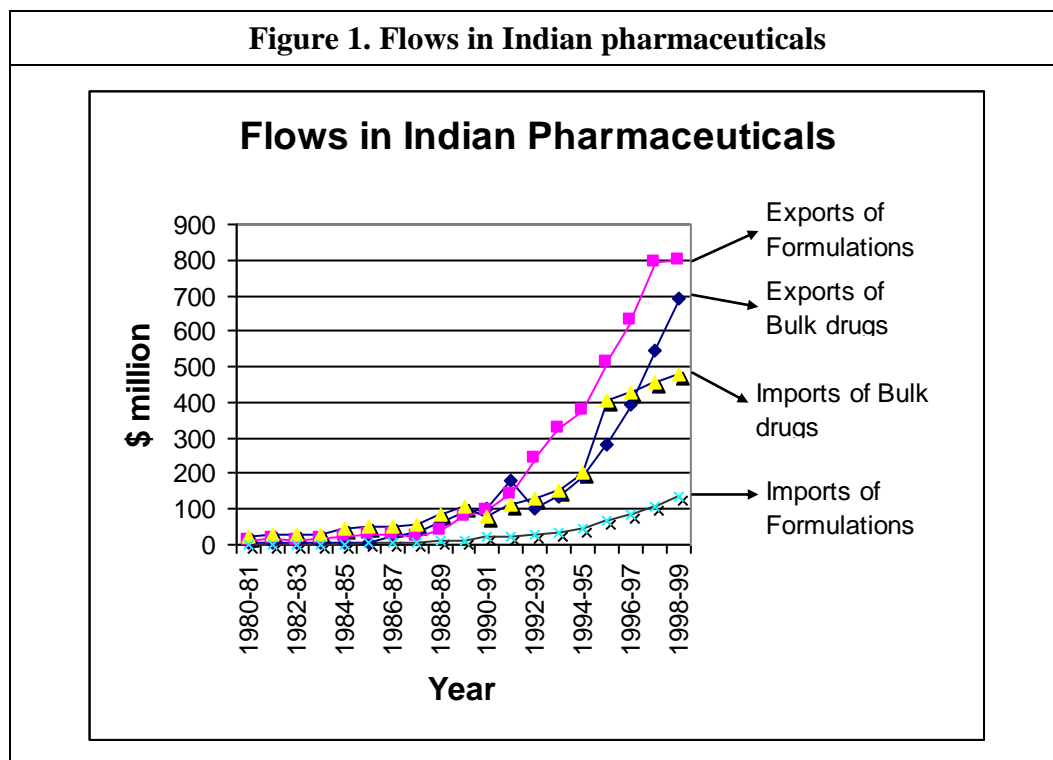
---

<sup>8</sup> Business World. India Pharma 2015 Sep 3, 2007; The Economic Times, Pharma Boom: Drug Market to hit \$20 bn by 2015, August 23, 2007.

<sup>9</sup>La pharma Indienne n’aide pas les Indiennes, 4 Sep 2007, Tribune des Droits Humains. [http://www.humanrights-geneva.info/article.php3?id\\_article=2152](http://www.humanrights-geneva.info/article.php3?id_article=2152).

<sup>10</sup> I.e. employing at least 10 workers with power or at least 20 workers without power.

<sup>11</sup> Comprehensive surveys of the Indian pharmaceutical sector giving further details can be found in Greene (2007) and Gehl Sampath (2006).



Source : Indian drugs and manufacturers Association.

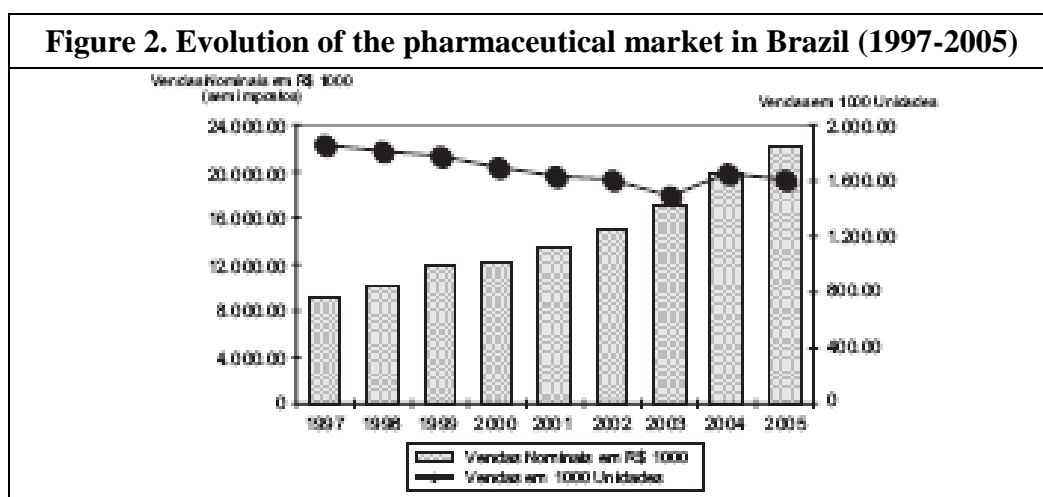
<http://www.pharmaceutical-drug-manufacturers.com/pharma-industry-statistics>

## 1.2. Brazil: with industrial capabilities but still technically dependent

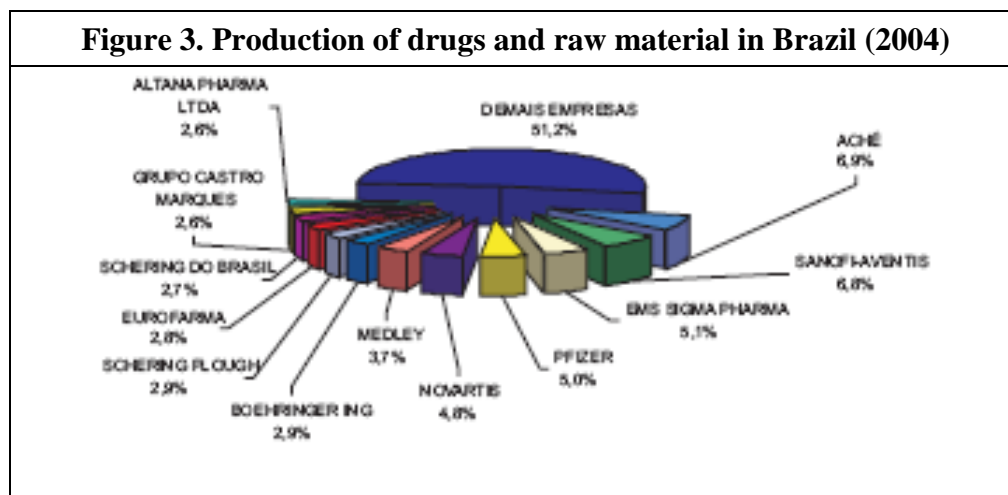
Given its size and its potential for growth, the Brazilian market is a favourite market for the top pharmaceutical firms in the world. In 1997, the Brazilian market for medicines represented 10.3 billion dollars in value, making it particularly dynamic as compared to other developing countries, especially in the Mercosur zone. In 2005, it was the 10<sup>th</sup> biggest market in the world with sales reaching 22.2 billion dollars with a growth rate of **xx in** terms of value of goods produced (Lemos de Capanema, 2006). However, such high growth in terms of value is accompanied by a significant decrease in the quantity supplied in market (refer to figure 2). Hence, the growth in value is not due to an increase in supply but to an increase in prices. In fact, the general inflation in Brazil between 1972 and 2005 ranged from 10% to 100% and there were repeated devaluations.

In terms of market composition, the Brazilian pharmaceutical industry is dominated by multinationals supplying about 70% of the local market against 30% by Brazilian firms (Cohen, 2000). Market concentration is relatively low. For instance, no firm holds more than 7% share of the market making the pharmaceutical market one with weak concentration (see figure 3), which in turn supports the scissors phenomenon of an inverse relationship between value of sales and volume of sales. However, as in India, when we close-in on niche markets, the concentration is much higher and prices charged by the leading firms, which are often Western multinationals, are much higher than on average (Wogart, 2004).

Local firms account for 80% of the medicines sold in the Brazilian market in terms of volume and 74.6% in terms of quantity. About 20 public laboratories contribute to 3% of national production in terms of value and 10% in terms of quantity supplied. The missionse laboratories have as their mission to produce essential drugs targeting public health programmes (Bermudez et al. 2004). Foreign firms have their production units to satisfy local demand, especially Indian generic producers and in total foreign firms supply about 10.3% of the market for generics.



Source : Lemos Capanema, 2006 from Febrfarm/Depto de Economia, reproduit dans Lucia.



Source : Fialho, 2005, cité dans Delgado Bastos.

The dynamism of the sector is attested by an increase in the number of firms in the pharmaceutical sector even though there have been waves of consolidations and closures. For instance, in the 1990's more than 2000 local firms shut down because of competition in terms of high quality (Sweet, 2007). Employment is also on the rise, going from 74 471 in 1996 to 95 634 employees in 2004 (see table1). The small scale sector with less than 20 employees makes up 64% of the market, while large firms with more than 500 employees account for

1.9% of the firms, with the residual 34.1% being taken by medium sized firms (Lemos Capanema, 2006)<sup>12</sup>.

	1996	1997	1998	1999	2000	2001	2002	2003	2004
Number of firms	686	715	691	720	707	779	799	826	824
Number of employees	74 47 1	76 92 4	77 36 6	81 23 0	83 48 7	89 16 8	84 13 1	87 68 2	95 63 4

Source : Febrapharma, 2007

Another important trend is the growth of the generics market. Between 2000-2003 generic producers in Brazil invested nearly a billion dollars in the construction and modernisation of their firms (Bermudez et al., 2004). Moreover, in 2000-2005, about 1140 new pharmaceutical products were granted marketing approval. The generics market increased from 1% of total pharma market in terms of both value and volume in 2000 to becoming 10.7% in terms of value and 13.5% in terms of volume by 2006 (Pro-Genericos, 2006).

The growth of the generics market has largely benefitted the incumbent leaders in the market (see table 2). About 53 firms operate in the generics market out of which 27 are domestic firms and 26 are foreign ones<sup>13</sup>. There are 4 Brazilian firms among the top 10 (EMS-Sigma Pharma, Aché-Biosintética, Medley et Europharma) and there are foreign firms from emerging countries like India (e.g. Ranbaxy) as well as European multinationals (e.g. Novartis).

Company	Volumes of sales (in millions of US dollars)	Percentage of generic market share (in %)
Medley (BRA)	1,79	24,11
EMS Sigma Pharma (BRA)	1,78	21,00
Biosintética (BRA)	1,12	14,58
Eurofarma (BRA)	0,907	10,54
Ranbaxy	0,435	10,04
Apotex	0,267	4,56
Merck	0,206	3,07
Novartis	0,17	4,30
Hexal	0,104	1,88
Mepha	0,1	0,04

<sup>12</sup> A noter toutefois que les statistiques disponibles font état d'un nombre variable d'entreprises en activité dans le secteur pharmaceutique, cela pouvant aller jusque 1077 entreprises en activité recensées (Lemos Capanema, 2006). Cela s'explique sans doute, comme dans le cas indien, par le nombre important de petites structures opérant dans le secteur.

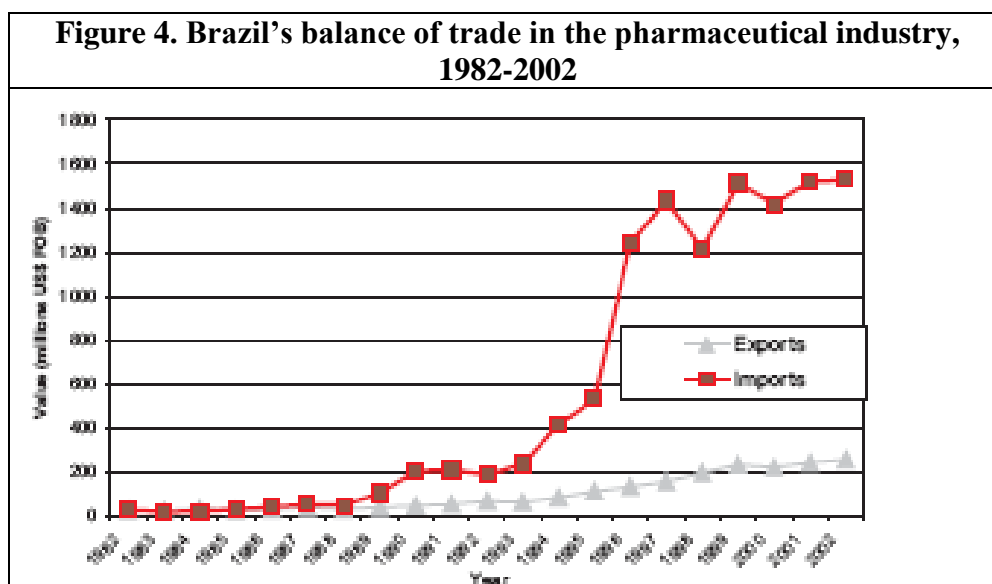
<sup>13</sup> The market for generics is very concentrated with 8 producers accounting for 90% of the market (Pro-Généricos, available on internet).

Source : Pro-Genericos, 2004.  
 BRA : domestic firms

These achievements however do not compensate for the persistence of ‘dependence’ of the Brazilian pharmaceutical market on foreign producers. Local Brazilian firms have developed competencies in formulation thanks to collaborations with public laboratories which have developed technological capabilities in formulations and production of essential drugs. But more than 90% of the core substance of drugs, the API are imported from India or China (Sweet, 2007). In fact, only 5 local firms have the capacity to produce API (Sweet, 2007). The case of drugs for HIV/AIDS where only the public laboratory Far-Manguinhos and one private firm jointly produce the API required serves as a typical illustration (Cassier et Correa, 2006). Moreover, because these particular API are produced in such small quantities without enjoying economies of scale, these API are 94% costlier than those supplied by the Indians or Chinese.

The principal reason for this retard seems to be because Brazilian firms do not invest enough to catch up in terms of manufacturing capabilities of API. The latter requires large capital investment in equipment and manufacturing installations and must be produced at a large enough scale to lower the average costs of production. This is possible only for foreign firms.

A consequence of such dependence is a consistent foreign trade deficit in the pharmaceutical sector from 1982 to 2002 except for the years 1983 and 1984. From 1982 to 2002, Brazilian imports increased by 224% overall, while imports in pharmaceutical products increased by 6112% (see figure 4). In parallel, exports of pharmaceutical products increased by 1104% while the global exports of the country increased only by 299.4% (Oliveira et al. 2004).



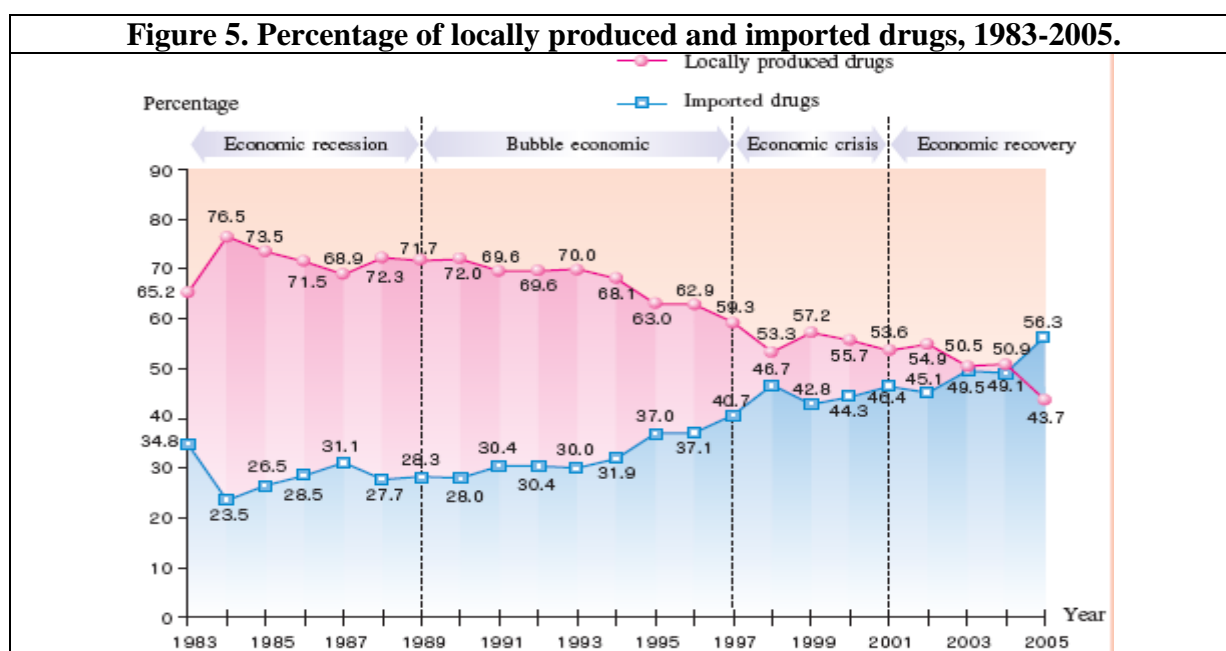
Source : Oliveira et alii, 2004, Elaborated from Anuario Estatístico do Brazil – FIBGE and SECEX/MDIC.

### 1.3. Thailand: a strong public sector but still technically dependent

The market value of the Thai pharmaceutical market is 1.32 billion dollars making it the 33rd largest market in the world. According to the projections of the WHO, it is likely to increase by 36 million dollars by 2009 (ISPE, 2006). However, the proportion of locally produced drugs has fallen steadily since the last two decades. In terms of value, local producers satisfied 65.2% of the market in 1983 but only 43.7% in 2005, with a peak of 76.5% in 1984. At the same time, imports have gained market share. It is only after 2004 that the shares have begun to reverse between locally produced medicines and imports (see figure 5).

The above trend is not surprising given that a strong presence of importers and foreign distributors marks the Thai market, made up of 486 firms (Wibulpolprasert, 2000). Foreign multinationals cater to about 45% of the market, imports take care of another 30%, local firms upto 15% and the public organization, the Governmental Production Organization or GPO, fills the residual 10%. The GPO produces and distributes essential drugs through public health programs.

There are two possible explanations. First, Thai firms suffer from a technological retard. For instance, 96% of API incorporated in locally sold medicines is imported (MOPH-NHSO, 2007). Less than a dozen firms including GPO produce API, thereby necessitating a dependence on imports from multinationals (Kuanpoth, 2006). The dominant activity of local firms is simply formulations, and to a modest extent in the packaging of imported drugs. Second, the reason can be traced to the nature of demand itself. Consumers seem to strongly prefer branded drugs from multinationals to locally produced generics.



Source : Drug Control Division and Drug Administration, Ministry of Public Health, 2005.



## **2. Future catching-up: A comparison of innovation capabilities**

### **2.1. India: R&D only for big firms and behind Western firms**

After the 1980's, market leadership in the Indian pharmaceutical market was bestowed only to firms with competence in chemical process technologies necessary to re-engineer targeted drugs. The knowledge base of Indian pharmaceutical firms was firmly embedded in organic and synthetic chemistry and any R&D investment was specifically targeted to lower the costs of production of selected drugs identified as having good commercial prospects, with the outlays just to the point needed to arrive at the objective (Ramani, 2002). In 1992, only about 47 companies, out of 23,000 odd firms in the pharmaceutical sector, registered positive R&D expenditures, of which only 7 companies spent more than 1.5% of their sales revenue on R&D. Thus, the common features of technological capabilities and strategy among all the leading firms included low R&D intensity, innovation focus on cost-efficient or quality enhancing processes and direct commercialization of innovation in countries where the product patent regime was not recognized.

Western multinationals contributed very little to innovation creation in India. Between 1970 and 1995 only two multinationals in India (Ciba-Geigy and Hoechst) had more than 2 patents list in the USPTO.

TRIPS represented a shifting of incentives for a firms in India, only allowing it to compete to become a first innovator and eliminating the possibilities of earning rent through being a second innovator. But given the retard of the pharmaceutical firms in crucial areas like biotechnology and lack of funds for R&D investment there was a real concern about whether TRIPS would undermine the innovative and industrial capacity of the thriving Indian pharmaceutical sector. This concern is was expressed not only by Indian firms but also by Indian civic society, which was worried that TRIPS may have a deleterious effect on access to future innovations that could include essential drugs.

A study based on interviews just prior to TRIPS enforcement revealed that pharmaceutical firms were adopting one or more of three types of strategic positioning in response to TRIPS (Ramani and Maria, 2005). First, the target for R&D is the creation of drugs, vaccines and diagnostics that are off-patent or are soon to be off patent, especially in regulated Western markets. Second, Indian firms are vying to participate in the international division of labour for the creation of new drugs by Western multinationals by offering contract research and custom manufacturing services, bioinformatics services for genomics based drug research, and carrying out clinical trials. Third, and in a smaller measure, some Indian firms are investing in the creation of new drugs for global diseases such as diabetes. Gehl Sampath (2006) also notes that the objective of the leading firms is to find the right mix of competition and collaboration with the multinationals in order to develop their dynamic capabilities.

The rationale behind these choices is of course quite clear. The comparative advantage of Indian companies is in reverse-engineering and process improvements that lowers the price of generics. The US market is the largest single-nation market for generics in the world and along with other lucrative European markets they are even larger. Leveraging the rents to their reverse-engineering capabilities by selling to these markets is a prime example of picking the low hanging fruit – and one that totally escaped prediction in the economics literature on the impact of TRIPS in India.

The other two strategic choices involved the development of new technological capabilities in new product and process innovations more linked to the different steps in the sequential process of bringing a new drug to the market. The launch of a new drug typically has to go through the stages of basic research, identifying the appropriate active pharmaceutical ingredients, combining these novel ingredients into a product, performing preclinical and clinical trials to test impact, identifying the right dosage and drug delivery system, seeking regulatory approval through completing a number of procedures, and finally marketing the new drug. Indian firms developed skills in the middle stages and the marketing but not in new drug discovery research techniques or preclinical or clinical trial methods. For Western firms, which are proficient in all the above steps but need to speed up and cheapen the drug discovery process, the presence of Indian firms proficient in reverse-engineering offers outsourcing opportunities. For Indian firms aspiring to become new drug manufacturers the task is rather more daunting. They have to develop absorptive capacity and technological capability in creating drugs, performing preclinical and clinical trials and seeking regulatory approval. Finally, they also have to build new capabilities to market new products through physicians in Western hospitals.

Thus, the second choice of strategy viz. becoming a cog in the wheel of an international division of labour and helping Western multinationals create their innovations is like the helping hand sought by a poor relative. Indian companies realise that they cannot match the deep pockets of Western multinationals as far as R&D budgets are concerned but want to avoid exclusion<sup>14</sup>. By partnering with Western MNEs in latter's new drug discovery endeavours, they hope to build new dynamic capabilities.

The third choice for innovation creation through new drug development, involves head-on competition with existing pharma majors and is clearly the road least travelled by Indian pharmaceutical firms for two reasons. First, high innovation rents can be reaped in Western markets for generics with more certainty. Another more important reason is the lack of significant complementary competencies required to create a new drug and get regulatory approval from agencies in developed countries. The drug development process starts with preclinical tests on animals on the basis of which a firm applies for an Investigational New Drug Application (INDA). At this stage the drug development process enters into a series of clinical testing phases, at the end of which a New Drug Application (NDA) is made with the regulatory authority. Then in order to enter the market some additional information and technical support may need to be provided to the regulatory authority and such requirements vary from country to country<sup>15</sup>. In the pre-TRIPS period, Indian firms largely skipped the INDA, phase I, phase II and phase III of clinical trials and went straight to the regulatory authorities for an NDA to prove bio-equivalence of the generic form of the drug and to satisfy the additional requirements to market the generic in India. Sometimes, even patents were not necessary. Thus, lack of competencies in the initial and final phases of new drug development are the Achilles heel of Indian firms.

Aggregate data however confirm the intentions of Indian firms to upgrade their technological ability. By 2005, about 109 pharmaceutical companies had positive R&D expenditures; out of which 81 had an R&D intensity of 1.2% and 28 firms had an R&D intensity of 8.79% (Chaudhuri, 2007). Yet, even by 2005 no Indian company had come up with a significant innovation in the form of a new drug based on indigenous R&D. Pradhan (2007) confirms that small firms spend either 0% or less than 1% of sales revenue on R&D.

---

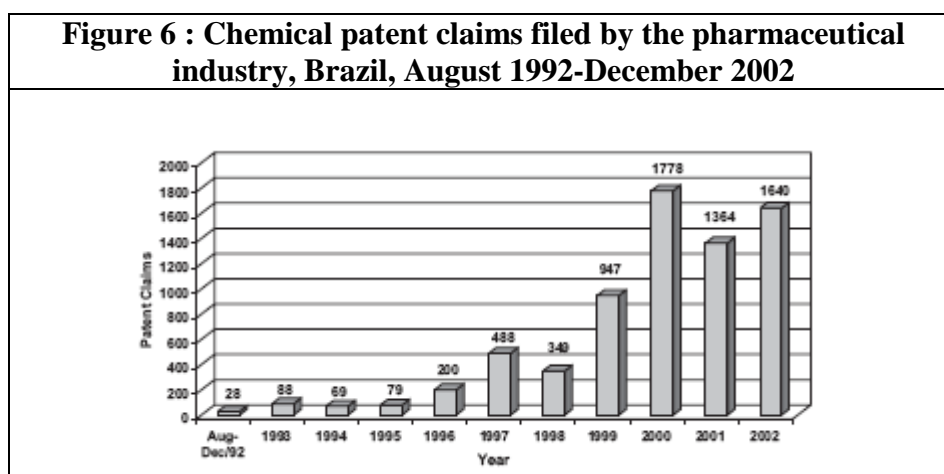
<sup>14</sup> Chaudhuri notes that the sum of the R&D expenditure of the top 11 companies in India million in 2005-2006 was \$379, while that of Pfizer was almost 20 times more at \$7440 million (2007, p. 6).

<sup>15</sup> In India the regulatory authority for the pharmaceutical sector is the Central Drugs Standard Control Organization.

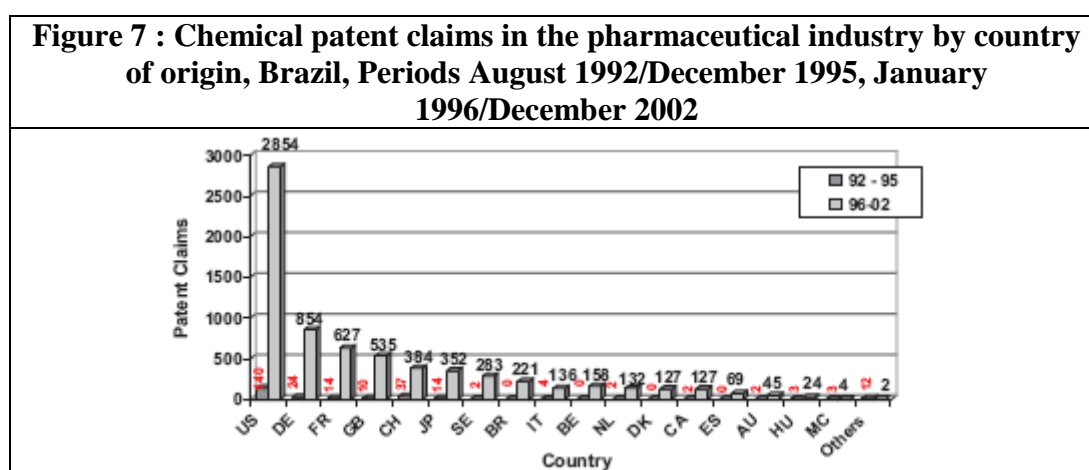
And there is still a great technological retard in recombinant technology or biopharmaceuticals.

## 2.2. Brazil: a committed public sector

Since 1992, there has been a significant augmentation in the number of patent applications. Oliveira et alii (2004) note that patent applications increased from 28 to 1640 between 1992 to 2002 with a peak in 2000, with Western multinationals accounting for most of the increase (see figure 7). American firms led the patent applications game with 140 patent applications over 1992-95 under the weaker patent regime and 2884 patent applications between 1996 and 2002, under the stronger patent regime (see figure 8). Germany, France, UK and Switzerland come behind the USA. Patent applications by local firms increased from 0 to 283 between these two periods but remain insignificant vis-à-vis those by the multinationals.



Source : Oliveira et alii, 2004, Elaborated from patent file data in RPI/INPI.



Source : Oliveira et alii, 2004, Elaborated from patent file data in RPI/INPI.

Oliveira et al. (2004) observe a nearly 33% decrease in contracts between local firms and foreign ones between 1992 et 2001 (see table 3). The most favoured form of technology

transfer during this stage was ‘licensing of brand-name’ rather than ‘joint-venture’ or ‘mergers’. Furthermore, licensing decreased from 94% to 34% by the end of the period because foreign firms preferred to export to more open markets rather than license their brand-name to local Brazilian firms. However, ‘technical assistance services’ seem to be rising.

**Table 3. Technology transfer contracts in the pharmaceutical industry, Brazil, 1992-2002**

TYPE/ YEAR	BNU	FRA	TS	PE	R&D	TAS	Other	TOTAL	% BNU	% TAS	% TS
1992	104	-	-	-	-	2	4	110	94.55	1.81	
1993	90	-	-	1	-	7	-	98	91.84	7.14	
1994	66	-	4	-	-	8	1	79	83.54	10.13	5.06
1995	50	-	-	1	-	8	3	62	80.65	12.9	
1996	49	-	3	1	2	11	1	67	73.13	16.42	4.47
1997	39	-	1	-	3	9	-	52	75	17.31	1.92
1998	14	3	5	-	-	11	-	33	42.42	33.33	15.15
1999	34	3	7	2	-	10	-	56	60.71	17.86	12.5
2000	22	2	6	1	-	15	-	46	47.83	32.61	13.04
2001	16	-	2	2	-	14	-	34	47.06	41.18	5.88

Source : Oliveira et alii, 2004, Elaborated from data published in RP/INPI.

Type of contract : BNU – License for brand name use ; FRA – Franchising ; TS – Technology supply ; PE – Patent exploitation ; R&D – Research and development ; TAS – Technical assistance services.

Cooperation in R&D between Brazilian and foreign firms also remains marginal. Most of the R&D in pharmaceuticals is carried out by public laboratories and the R&D investment by Brazilian firms is very low. In 2005, the R&D expenditure on pharmaceuticals within the geographical territory of Brazil touched 125 millions de dollars (Lemos Capanema, 2006). The ‘Brazil National Development Bank (BNDES)’ is in charge of providing financial support for the R&D programs, modernisation of production units and mergers and acquisitions by Brazilian firms. The low level of activity of the BNDES is gauged by the fact that between 2004 et 2007 it financed only a dozen R&D projects (Sweet, 2007).

Public laboratories are very active in national research programmes. In particular, Far-Manguinhos participated in the conception and design of new treatments for HIV/AIDS, with the help of other public institutions. Finally, the research carried out by the Federal University of Rio de Janeiro combined with the development activities Far-Manguinhos gave rise to the patenting of a drug against AIDS (Cassier and Correa, 2006)<sup>16</sup>.

### 2.3. Thailand: Technology transfer not much of a help

<sup>16</sup> Comme le suggèrent très justement Cassier et Correa, le développement de compétences en formulation développées sur la base du reverse-engineering et le learning by copying expliquent pour beaucoup l’implication aujourd’hui de Far-Manguinhos dans le champ de R&D. Sans cette phase de dissection, d’analyse et de reproduction des molécules existantes, somme toute d’apprentissage, cette unité ne serait pas capable aujourd’hui de coordonner des programmes de R&D dans le champ du VIH/Sida.

The available data, which is not much to start with, indicates that local firms and the GPO do not invest much in R&D (Kuanpoth, 2006). However the GPO does invest in development activities related to known medicines. For example, it conceived of a HIV/AIDS drugs cocktail, the GPO-VIR, composed of three medicines patented separately before 1992 by the multinationals (Guennif et Mfuka, 2003). Similarly, some public institutions such as university laboratories carry out R&D to valorize traditional knowledge. However, due to lack of resources, this investment rests marginal.

Given the absence of significant R&D investment by local organizations, technology transfer from Western multinationals emerges as a possible source for the creation of technological capabilities. According to a study by Supakankunti et al. (2001), there has been very little increase in FDI in Thailand since 1992 (see table below). Furthermore, another survey study revealed that 82% of the directors in the pharmaceutical industry are of the view that very little technology transfer has taken place and multinationals simply try to exploit the capacity of formulations of national enterprises without promoting technology transfer. (Supankankunti et al., 1999).

There are a number of reasons for the fall in FDI in Thailand.

First, neighbouring countries offered a better business climate. Dhanarajan (2001) notes that a number of R&D intensive multinationals in fact relocalised their Thai offices to Singapore despite the reinforcement of the patent law in Thailand. The argument advanced by Professor Chitman, Executive Director of the Pharmaceutical Producers Association (PPA)<sup>17</sup>, is that Singapore offers more incentives than Thailand: lower corporate taxes, rapid registration procedures, easier work permits for expatriates (Dhanarajan, 2001). Other firms relocalized their activities to countries where labour costs were lower such as Vietnam (MOPH, 2006).

<b>Year</b>	<b>Valeur de la part détenue par les propriétaires thaïlandais (baht)</b>	<b>Valeur de la part détenue par les propriétaires étrangers (baht)</b>	<b>Total (baht)</b>
1992	16 597 800	3 002 200	19 600 000
1993	105 507 000	93 000	105 600 000
1994	150 050 020	31 049 980	181 100 000
1995	36 160 000	11 540 000	47 700 000
1996	212 182 200	129 017 800	341 200 000
1997	39 240 000	2 760 000	42 000 000
1998	138 782 870	4 359 000	143 142770
<b>1992-1998</b>	<b>698 519 890 (79.4)</b>	<b>181 822 880 (20.7)</b>	<b>880 342 770</b>
<b>1992-1996</b>	<b>520 497 020 (74.9)</b>	<b>174 702 980 (25.1)</b>	<b>695 200 000</b>

Les valeurs entre parenthèses sont en %.

Source : Supakankunti et al., 2001.

<sup>17</sup> La PPA représente les firmes multinationales en Thaïlande.

Multinationals saw no need to increase FDI because they preferred to import from their home countries rather than invest in local production. This is also the reason for the increase in imports since 1992. Mostly when multinationals engaged in production it was in the final stage of formulations, importing API from home countries.

Another significant factor is market size. The Thai market is smaller in size than the Brazilian, Chinese or Indian ones. Given a small market size there is little incentive for multinationals to establish their production units in a sector where the economies of scale play a critical role in the localization strategies. It is in the interests of patent holders to import finished products or just do the final stages of formulations in the country concerned.

Finally, often the local organizations did not find offers of technology transfers to be win-win prospects. According to, Krisana Kraintu, a previous director of the R&D unit of the GPO, multinationals are only interested in making use of the competencies of local firms in formulations in order to reduce their own costs of production and marketing. There is usually very little scope for real technology transfer or technical assistance in collaborations with multinationals. As an illustration, one can cite Boehringer, which proposed a license to GPO to produce Névirapine (a drug against HIV/AIDS) in dry syrup for children, a product patented in Thailand, as the multinational was aware that GPO was technically capable of producing the same. The government agency refused. Then in order to benefit from the distribution network of GPO, Boehringer proposed to GPO to be the distributor of Névirapine in Thailand.

### **3. Role of IPR**

#### **3.1. India: Vive re-engineering**

Just after independence in 1947, in India, there was no pharmaceuticals industry to speak of. Thereafter, during the 1950s and 1960s, a pharmaceutical sector developed, consisting mainly of western pharmaceutical giants and Indian public sector mammoths. However, even the Indian public sector combined with western pharmaceutical companies could not cater to the demands of the Indian population. Moreover, in order to ensure access to drugs, the government pegged prices at affordable levels, lowering incentives for the expansion of the production base. In short, there was a crisis in terms of provision of healthcare.

There were two possible solutions to this healthcare emergency. Either medicine could be imported in large quantities as essential commodities or incentives could be provided for the development of the local pharmaceutical industry by loosening IPR. The Indian government opted for the latter solution. Following the strategy adopted earlier by Japan, China, Russia and eastern and southern Europe, the existing IPR, the Indian Patent and Design Act of 1911 was changed. From 1970 onwards, instead of granting both process and product patents, the new IPR regime began to recognise only process patents.

The Indian Patent Act of 1970 thus constituted a 'narrowing' of the IPR regime (in opposition to TRIPS), increasing the incentives for Indian firms as second innovators. The impact of the change in IPR was simply tremendous. Many Indian pharmaceutical firms were able to produce essential drugs like antibiotics with a heavy slashing of prices. Indian consumers revealed themselves to be price sensitive rather than being brand loyal to western brands. The market shares changed tremendously, bearing witness to the downfall of the previous market leaders, mainly western multinationals. Most importantly, the public Indian healthcare system was finally able to stand up on its feet and there was a significant increase in the proportion of the poor who had access to basic drugs. Indian firms even entered into

production contracts with the original multinational inventors, permitting them also to enjoy lower costs, and a greater mark-up. India became an exporter of bulk drugs and final therapeutics, supplying many parts of the developing and developed world at lower costs.

Table 5 below shows the top ten companies for selected years 1970, 1996 and 2003, and they clearly reveal what a weaker patent system can do to spur competition. It allowed Indian firms to adopt 'duplicative imitation' and 'creative imitation' as strategies for technology capability development (Kale and Little, 2007). The growing strengths of the domestic firms are reflected in the table, in which the figures in parentheses indicate the market shares to each firm. Thus, in 1970, the Indian market was clearly dominated by multinational firms and eight of the top ten firms were MNCs. After two decades following the 1970 Patent Act, Indian pharma was dominated by domestic firms and only 4 of the top ten firms were now multinational. By the mid 1980s most Indian pharmaceutical firms were producing bulk drugs and formulations for the domestic market and the leading domestic firms (e.g. Ranbaxy) had begun to explore markets in Asia and Africa.

The Indian case study shows that in a developing country, with an excess demand and a significant technological retard in a knowledge intensive sector, a narrowing of the IPR regime can serve to create industrial competence and also increase welfare. This is of course provided that the national system of innovation, including the existing scientific and technological competencies, is so developed as to permit the local firms to emerge as second innovators. The case study also shows that a narrowing or a loosening of the IPR might be welfare enhancing, if it leads to a greater quantity being produced and/or a lowering of price in the final market. It might be welfare enhancing even at a global level, if other developing countries are able to thereafter obtain the generic versions of the knowledge intensive commodity more easily or at lower prices.

<b>Rank</b>	<b>1970 Company (Market Share in %)</b>	<b>1996 Company (Market Share in %)</b>	<b>2003 Company (Market Share in %)</b>
<b>1</b>	Sarabhai (4.97)	Glaxo-Wellcome* (4.97)	GlaxoSmithKline* (5.6)
<b>2</b>	Glaxo* (2.9)	Cipla (2.98)	Cipla (5.5)
<b>3</b>	Pfizer* (2.6)	Ranbaxy (2.67)	Ranbaxy(4.7)
<b>4</b>	Alembic (2.6)	Hoechst-Roussel*(2.6)	Nicholas Piramal (3.4)
<b>5</b>	Hoechst* (1.7)	Knoll Pharma* (1.76)	Sun Pharma (3.1)
<b>6</b>	Lederly* (1.7)	Pfizer* (1.73)	Pfizer* (2.7)
<b>7</b>	Ciba* (1.6)	Alembic (1.68)	Dr. Reddy's (2.6)
<b>8</b>	May & Baker* (1.6)	Torrent Pharma (1.60)	Zydus Cadila (2.5)
<b>9</b>	Parke Davis* (1.5)	Lupin Labs (1.56)	Abbott* (2.3)
<b>10</b>	Abbott* (1.5)	Zydus-Cadila (1.51)	Aventis – includes merger with Hoescht * (2.2)

\* indicates a multinational firm

Source: OPPI, 2000, 2003; Lanjouw, 1996.

The 1990s saw a number of changes to the regulatory environment facing Indian pharma firms. In 1991, the economy was liberalised and the pharmaceutical sector was de-licensed. In 1995, 50% of the drugs were also removed from price control and by 2004 only 76 drugs (26%) remained under price control<sup>18</sup>. Liberalisation of national and international financial transactions followed in 1995. Production, exports and imports shot up after the adoption of economic reforms (see figure 1). The industry grew rapidly in the 1990s, with an average industry growth rate of about 15% for bulk drugs and 20% for formulations (OPPI, 2001).

Hot on the heels on liberalisation, India became a member of the WTO in 1995 and thereby agreed to change the regulatory framework in accordance with the TRIPS convention, a mandatory condition for WTO membership. Between 1994, when TRIPS was signed by India, and 2005 when it came into effect in India, three amendments to the patent law of 1970 were passed in the Indian Parliament to make it TRIPS compliant. They were the 'Patent First Amendment Act' in 1999, 'Patent (Second Amendment) Bill' in 2002 and the 'Patents (Amendment) Bill' passed in 2005.

The decade preceding TRIPS was also marked by technological upheavals and radical regulatory reform in Western markets. Policy makers in Western countries also became more sensitive to the need for developing the market for generics drugs, in order to bring down the costs of providing health care and decrease social security payments to its citizens. Ironically, these concerns were quite similar to those which had provoked the Indian Patent Act of 1970.

<sup>18</sup> Figures from OPPI (2004).



The USA pioneered new policies designed to decrease spending on medical care and the Hatch-Waxman Act was passed in 1984 to stimulate the market for generics, lower prices and enable greater accessibility to healthcare for its citizens. Prior to this law, a generics producer could not apply for marketing approval until after patent expiration and had to submit the full experimental and clinical data as is required for a new drug to prove safety and efficacy. This delayed market entry by as much as 3 years after patent expiry. With the Hatch-Waxman Act, manufacturers of generic drugs no longer had to go through a lengthy period of extensive clinical trials - demonstration of bio-equivalence was sufficient to acquire marketing approval for a generic drug. European countries followed suit but the situation remains confusing as its national laws remain different.

Just as the Indian patent law of 1970 had made the pharmaceutical market more competitive, the legislation to make entry into the generics market easier in Western markets beckoned new entrants from India such as Ranbaxy and Dr. Reddy's Laboratories. Ranbaxy was the first company to spot the opportunity offered by the US generics market and started preparations to enter it long before liberalisation and TRIPS. It was also the first company to use the ANDA filing route to enter the US generics market directly. It used the steady but low return Para 1 to Para III approach of ANDA filings, where the generic manufacturer enters the market only after expiry of the product patent and securing a niche in the US antibiotics segment. On the other hand, Dr. Reddy's Laboratories adopted the more aggressive strategy of Para IV filings, invalidating existing patents or producing non-infringing process through a costly process of litigation. In 2001, DRL became the first Indian company to launch Fluoxetine (a generic version of Eli Lilly's Prozac) with a 180 day market exclusivity in US. This marketing success was followed by the launch of Ibuprofen tablets 400, 600 and 800 mg in the US under its own brand name, in January 2003. The success of Ranbaxy and Dr.Reddy's spurred other Indian firms to attempt to enter the US generics market.

Another recent trend among the leading pharmaceutical firms is internationalisation either through initiation of strategic alliances with Western companies, with the Indian firm being the first mover, or through outright buy-outs. While more strategic alliances have been forged with US companies, there have been more acquisitions in Europe (Greene, 2007).

### **3.2. Brazil: Overdoing it with TRIPS**

At the beginning of the last century, Brazil was characterized by a strong IPR regime granting both process and product patents. However, incentives were provided for second innovators from 1945 by limiting patentability to processes only and this was further reinforced from 1969 with patents being entirely prohibited in the pharmaceutical sector (Frischtak, 1989). Under pressure from the Commerce Department of the United States Government, from 1991 onwards there was a reflection on how to reinforce the IPR regime. Without even making use of the clause permitting Brazil to implement TRIPS by 2005, Brazil proceeded with a new reinforcement of its patent regime in 1996 with the ratification of TRIPS<sup>19</sup>. By a Presidential decree both product and process patents with a 20 year validity period were reintroduced.

With respect to the flexibilities embedded in TRIPS, on the one hand, Brazil restricted its ability to use **parallel imports** by introducing the principle of « National exhaustion of

---

<sup>19</sup> During the Uruguay Round and even before the ratification of TRIPS by the member countries of WTO, Brazil was the target of commercial sanctions from the United States from the end of the 1980s and was under the threat of "Special 301" sanction right from 1988. Consequently the tariffs on certain Brazilian products such as electronic items and certain drugs, exported to the US increased (Wogart et Calcagnotto, 2006).

rights ». Unlike in “regional or international exhaustion of rights” that permits a country to import drugs from countries where they are sold at the lower price, under national exhaustion one can buy from the lowest bidder only within the country. Therefore, it is difficult to fight against oligopolistic or monopolistic fixing of prohibitive prices or market rationing through insufficient production.

On the other hand, Brazil put in place regulation that permitted it to make full use of **compulsory licensing**, a policy tool by which the State can authorize a local company to produce a copy of a patented drug through procurement of a license from the original innovator, in the case of a national emergency. Whenever local production was not started by a foreign supplier within three years, Brazilian law permitted the octroi of a compulsory license<sup>20</sup>. Such a move led to heated debates and a renewal of “Special 301”<sup>21</sup> and a deposition of a complaint by the USA to the « Dispute Settlement Body » of the WTO in 2001. It was argued that it constituted discrimination to foreign suppliers, a practise not permitted under TRIPS. However, the USA eventually withdrew this complaint once Brazil pointed out that such a clause also exists in US legislation. Brazil committed itself to informing the US agencies whenever it intended to impose a compulsory license on any supplier.

Over time, Brazil progressively refined the conditions under which compulsory licenses could be issued. At first, the law of 1996 limited the scope of imports under compulsory licensing by establishing the rule that a drug be imported only from a country, where it was marketed by the patent holder or by authorized third parties. This meant that imports could not be had from a country where the original innovator had not deposited a patent. For instance, Brazil could not import drugs from generic producers in India, because the original innovators had not deposited a patent in India. Under the Doha Déclaration of 2003<sup>22</sup>, signatories of TRIPS can take measures to ensure accessibility to essential drugs. For instance, a country which does not have the technological competencies or manufacturing capabilities to produce a certain drug, can issue a compulsory license to a firm located in another country to produce and supply a drug. In order to remove such constraints the Brazilian law was changed in 2003, authorizing imports of drugs that could not be locally produced, from countries in which the drug was not patented. Thereby, Brazil was able to import less costly drugs from India, which were often also more user friendly, reducing the risk of resistance and therapeutic failures. For example, in the case of HIV/AIDS, the Indian generic cocktail reduced intake from 12 tablets per day to 2 per day.

Furthermore, Brazilian law recognized the Bolar principle contained in the Patent laws of the USA and TRIPS that provides incentives for the early entry of generics. Using the Bolar provision of TRIPS, countries can fine-tune their IPR so that local firms have the possibility of investing in R&D to develop competencies in formulation and production of a patented

---

<sup>20</sup> This is similar to the notion of « working patent » that was present in the Thai and Indian patent legislations till 1992 and 2005 respectively. Expliquer plus ....

<sup>21</sup> The policy « 301 special » is a tool utilised by the United States since 1984 to exercise commercial pressure on countries with practises that pose a risk to the economic interests of the USA through the adoption of standards judged inadequate in the realm of IPR. This tool has been repeatedly denounced by the WTO because it is considered to be illegal as it violates the principle of multilateral resolution of disputes after submission to the “Disputes Settlement Body” of the WTO.

<sup>22</sup> Following objections raised by African countries which declared that they could not benefit from the application of compulsory licenses as they did not have manufacturing capabilities, the Ministerial conference of the WTO at DOHA in 2001 commanded the TRIPS council to find a solution by 2002 end. By August 2003, some months after Cancun, a solution was found: an additional flexibility was introduced by the member nations so that countries without manufacturing capabilities could import from generic producers with compulsory licensing.

drug. They can also be allowed to initiate administrative procedures for obtaining marketing approval of generic so that the generic can be introduced in the market as soon as the patent for original drug expires.

With respect to **protection of data on clinical trials**, TRIPS gives leeway simply requesting member countries to initiate legislation to protect against 'unfair commercial use' and in response Brazil has put in place a dual system. For new chemical molecules the protection is assured for 10 years<sup>23</sup>. For the molecules, which are not new, embodying a minor amelioration, the protection will be for five years. In practice, it signifies that if the patent has expired for a drug but the clinical trials data is still protected, the firm which desires to produce a generic cannot use the clinical trials data of the original patent holder to constitute a dossier for gaining market approval. In other words, the concerned firm has to re-do new clinical trials to demonstrate its efficiency and the innocuity of the generic or me-too version, calling for replication of effort and costs and leading to high final market prices.

In addition to these principal modifications of the Brazilian system of patents, there were another series of modifications in the regulation that affect the final market prices and the quality of drugs supplied in terms of its gave importance quantity and quality of drugs available. In fact, at the moment when Brazil was defining step by step the main framework of the new IPR regulation in the pharmaceutical sector, in parallel it invested considerable effort to satisfy the health needs of the population, via focussing on the question of ensuring an adequate supply of essential drugs.

As with a number of developing countries subjected to liberalisation measures, opening and deregulation of markets as ordered by the IMF<sup>24</sup> during the 1990s, inflation soared in Brazil and its currency was repeatedly devalued. This translated into a difficult access for medicines. The increase in prices provoked irregular intake of medicines among the poor sections of the population, which in turn contributed to the building up of disturbing resistance to available treatments.

In order to rectify these perverse effects, the public agencies put in place a formal system of public bidding via the law called 'Law of Tenders' in 1993. In order to promote competition and improve the access to medicines, public procurements representing 26% of domestic market sales was channelled through 'open auction' procedures (Sweet, 2007)<sup>25</sup>. Only market price was taken into account without much attention being paid to quality.

The 'Basic pharmacy program', whose objective was to improve access to 40 essential medicines, was initiated in 1997, in conformity with the constitutional right of Brazilians to health. One of the first measures taken was the dissolution of the national agency CEME which was created in 1971. This institution had as its mission the coordination of the production and distribution of drugs produced within the country, especially those produced in the public laboratories (Jorge et al., 2004). But charges of corruption and failure to meet its objectives led to this decision<sup>26</sup>.

Immediately, a research group was constituted by the Ministry of health to define the main framework of a national policy on drugs. A report edited in 1999 enunciated its principal

---

<sup>23</sup> This protection of data on clinical trials for a duration of 10 years is also included in most bilateral free-trade agreements signed between the USA and countries of the South (Guennif, 2006, Rossi, 2006).

<sup>24</sup> In the Brazilian case, the opening of the markets and the liberalisation of the economy have given rise to lowering of tariff on pharmaceutical products from 70% to 14% (Sweet, 2007).

<sup>25</sup> In volume this proportion is higher.

<sup>26</sup> Though it fulfilled its mission of procurement and distribution of medicines within Brazil, it failed in fulfilling other objectives such as assuring the quality of drugs, supporting technological development and local R&D.

objectives as follows : adoption of a list of essential medicines, health-related regulation of medicines, promotion of rational use of medicines, scientific and technological development, promotion of production of medicines, safety, efficacy and quality assurance, development and training of human resources.

The objectives of public health and industrial development were put forward because of concerns about the ability to supply safe and efficient drugs of quality to satisfy the needs of the population, while drawing upon local production as much as possible. One of the first actions was to bring the list of essential medicines lastly listed in 1982 upto date and create in 2001 a commission to update this information regularly. Even if at first the 'Basic Pharmacy Program' had a centralized structure of public procurement, very soon the Health Ministry opted for a set of federal purchases for the different internal states.

In 1999 the public agency **ANVISA**, the equivalent of the American FDA was created. Its duties consisted of monitoring the production of drugs for safety and efficiency, setting price ceilings and advising the National agency of intellectual property rights when their patent are deposited, evaluating in particular the novelty of the patent submission.

The same year, always with the objective of promoting the supply of medicines at an affordable price, the **Generics Act** was promulgated. It is important to note that till that date, like in other developing countries, in the Brazlilan market, there exists three types of medicines: the original innovation drug, generics and 'me-too' drugs. The last was slightly different from the original drugs but contained the same active principles, had the same therapeutic effects, were given in the same dosage with same mode of delivery as the original innovation. In return, the producers of me-too drugs did not have to demonstrate the interchangeability of their products with the original drugs on the basis of tests of bio-equivalence<sup>27</sup>.

Unintentionally, the Generic Act elevated the safety norms and made tests of bioequivalence mandatory for any 'me-too' drug to gain marketing approval unlike generics (Hasenclever et alii, 2000, Sweet, 2007)<sup>28</sup>. Therefore, the latter disappeared progressively and was replaced by sales of generics. In order to assure price stability, the law insisted that the price of generics must be at least 33% lower than that of the princeps.

The objective of this measure is, as in a number of developed and developing countries, to increase the competition on the pharmaceutical and to support the consumption of generics, which are cheaper than the patented drugs. Instead of submitting to additional costs, via the realization of tests of bioequivalence and investing to increasing the quality, the efficiency and the safety of their drugs, the local industry was able to tap the international generics market. This of course did not fail to provoke strong reactions from the multinationals present in Brazil, which saw in the 'Generics Act' a move designed to reduce their local market shares<sup>29</sup>.

### **3.2. Thailand IPR: Boosting quality rather than quantity**

From 1984 the Thai FDA launched a campaign to promote 'Good Manufacturing Practices (GMP)' to promote the safety, efficiency and quality of drugs before market release. This is

---

<sup>27</sup> These are clinical tests demonstrating that generics have the same therapeutic effects as the original drugs.

<sup>28</sup> These minimum standards also concern the promotion, the packaging and the marketing of generics (Hasenclever, 2000).

<sup>29</sup> D'où des campagnes vantant la qualité des princeps et mettant en avant la qualité médiocre des génériques produits sur le marché brésilien.

because the existing procedures for the inspection of local production units, locally produced medicines, imported drugs and those sold in pharmacies were deemed insufficient to assure quality. Producers, importers and distributors were therefore required to adhere to new GMP standards. Thus, the 6th (1987-1991) and the 7th (1992-1996) national plans of economic and social development included programs under which the Thai authorities promoted and helped the local producers to adopt GMP by organizing seminars, annual training workshops for the personnel of private firms and public institutions, diffusion of technical documents and the realisation of audits in producing firms (FDA, 1999).

The main obstacles to GMP adoption were the conditions laid down on investments, personnel et technical know-how and insufficient legal measures to facilitate these procedures. The GMP was not obligatory by law till 2004 but it was necessary to gain marketing approval. From 1993 onwards, a test of uniformity of content was required for drugs containing less than 2 milligrammes of the active principle per dose. For all imported drugs and for 12 drugs produced locally, tests of stability were required before registration. The same year, studies of bioequivalence were made mandatory for registering generic drugs.

Monitoring and inspection of drug producers, specially those without certification of GMP were put in place in a transition phase during which GMP certification was not obligatory. Furthermore, since 1992, the Minister of Health obliged the government hospitals to purchase their medicines from only producers with GMP certification. The Thai FDA demanded pharmacies to do likewise.

In this manner, the State tried to improve the quality of medicines produced locally by playing the the card of improving production conditions. By forcing the firms to conduct tests of bioequivalence and the hospitals and pharmacies to buy only from GMP certified producers, a real attempt was made to improve the quality of medicines available. Moreover, the Health authorities edited a list of essential medicines, basing it on the WHO model et called upon hospitals to stock upto 80% of the medicines given in the list.

**Strengthening the IPR regime:** In 1992, when the member countries of the WTO were in the process of negotiating the contents of the treatise that would later emerge as TRIPS, under pressure from the commerce department of the USA, Thailand revised its patent law of 1979 (WHO, 1999, Dhanarajan, 2001, Guennif et Mfuka, 2003). Before 1992, only processes were patentable. However, from 1992, both product and process patents were allowed, and all drugs invented elsewhere in the world were also patentable in Thailand. Patent protection was granted for a duration of 20 years, during which no generic could be produced.

In parallel, the « Safety Monitoring Programme » was put in place the same year under pressure from the American representatives of trade and commerce (Dhanarajan, 2001). Officially the SMP has as its targets to assure the security, efficiency, and quality of products before the granting of marketing approval in Thailand. This program does not concern the entire set of medicines arriving in the market, but uniquely those for which a patent has been deposited elsewhere in the world between 1986 and 1991. In other words, the program covers chemical entities, combinations of drugs, delivery systems new to the Thai market but already patented elsewhere.

This permitted health authorities to put a drug under protocol of post-marketing inspection for two years. During this period, the drug would not be available in the pharmacies but uniquely in the public hospitals and the clinics, since it was deemed that only then could examinations be organized to test for efficiency, safety and quality. More importantly, during this phase of inspection and waiting for marketing approval, all production of generics is prohibited.

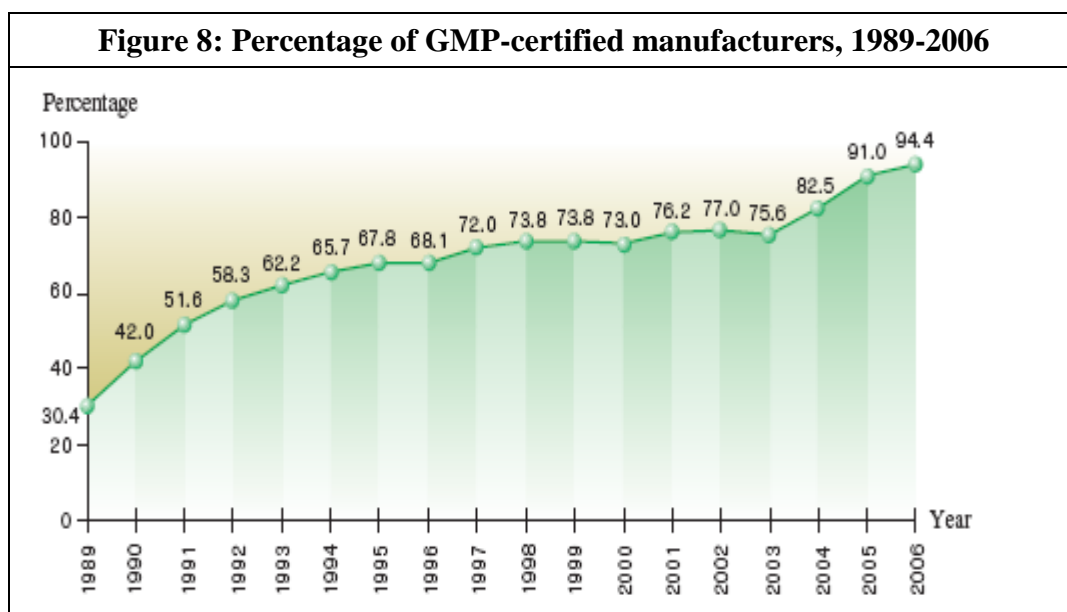
To sum it up, the SMP permitted producers, mainly multinationales to obtain exclusive rights for commercialization in public hospitals and clinics. Initially the protocol was valid for two years; whereas by 1993, Thailand fell under the blow of '301 Special' American and prolonged the duration of commercial exclusivity. Furthermore, firms can demand two year extension of SMP. At the end of these two years, they have about six months to analyze the data collected on the safety, efficiency and quality of the product and submits them to Thai FDA. Then after an additional six months, they can gain market approval. Thus, the duration of commercial exclusivity is finally extended to a period of 5 years, during which no local production or importing of generics is permitted. In other words, SMP and the law on patents were combined advantageously to offer exclusive commercialization rights and monopolies to foreign producers whose patents dated at least 1986.

In addition to the introduction of patentability of drugs, in 1992 parallel imports were also banned following threats from USA to limit the imports of Thai textiles. An year after such banning, under renewed American pressure, the Thai government abolished compulsory licenses that were earlier included in the Thai Patent Act. In return, the preferential tariff treatment was promised for exports of jewels and wood products exported to American markets.

Then came TRIPS in 1994. Five years elapsed before the Thai patent laws were amended to be in conformity with TRIPS, with a patent protection duration of 20 years. Conforming to TRIPS, the law was amended to reintroduce parallel imports in the Thai system and despite pressure from the US, compulsory licenses are an integral part of the Thai patent system. However, following TRIPS, they can be applied only in the case of national emergency. Also, it is very much possible de exclude patentability of drugs vital for the population and thereby permit the production of generics of drugs in the case of health crises.

What was the impact of these safety norms? A natural consequence was that the number of firms with GMP certification increased over time. In 1989, 30.4% of the producers (58 firms) had GMP certification (see figure 9), including GPO. In 2000, this figure rose to 73% of firms (or 130 units) and by 2006, 94,4% of the producers had GMP certification.

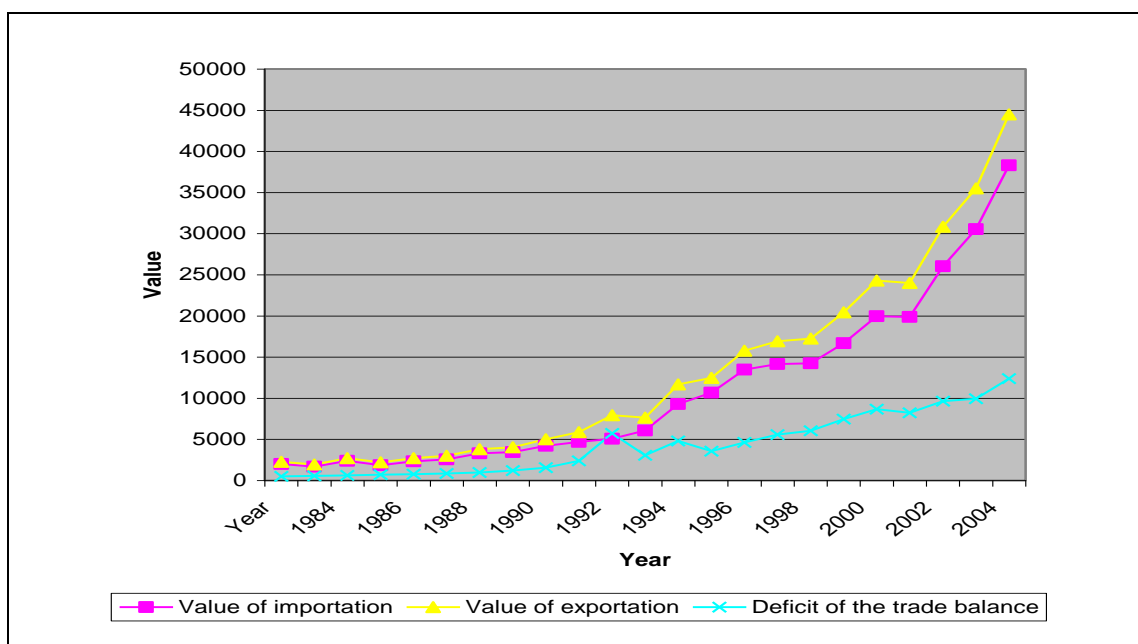
At the same time, this trend hid another phenomenon : a number of firms that were unable to bear the costs of upgrading their equipment and manufacturing units and recruiting qualified personnel, in order to obtain GMP certification, were forced to shut down. For instance, there were 191 producers in 1989 against 176 in 1999 just after the Asian crisis. The last count in 2006 revealed 171 local firms (ISPE, 2006).



Source : Drug Control Division and Drug Administration, Ministry of Public Health, 2007.

A second positive impact was that Thai drugs improved in quality and safety and stimulated Thai firms to export their products. But even if the Thai market became dynamic it remained very small as compared to the markets of neighbouring countries like India or China or far-away emerging economies like Brazil. Opportunities for exports also continued to rise with the constitution of ASEAN regrouping around 10% of the world population and between 1983 and 2005, exports increased 24 times growing from 255.6 million to nearly 6.2 billion bahts. But it must not be forgotten, that such a rise in exports was accompanied by a rise in imports (see figure 9).

**Figure 9: The trade balance of the pharmaceutical sector**



In million baths

Source : Drug Control Division, Food and Drug Administration, MoPH.

#### 4. Discussion : Determinants of Catching up in terms of industrial competence

The three countries studied, India, Brazil and Thailand have all made considerable strides in catching-up, but display very heterogeneous patterns.

All three countries have local manufacturing bases producing generic formulations out of bulk drugs. However, only India produces biogenerics and active pharmaceutical ingredients that form the basis of bulk drugs. Indian firms have manufacturing bases not only in India but in other developed as well as developing countries (e.g. in 1977 Ranbaxy set up manufacturing units in Nigeria and in 2000 acquired Bayer Generic Business).

All three countries market products of local firms in their market and export to other developing countries. But the zone of exports is most limited in the case of Thailand, bigger for Brazil and the largest for India. For instance, the Thai public unit GPO exports medicines, essentially in the Association of Southeast Asian Nations (ASEAN), in countries-members like Malaysia, Myanmar, Vietnam, Laos or Cambodia whereas Brazilian firms export mainly within the MERCOSUR. India, on the other hand exports both to developing and developed country markets. Indian firms such as Ranbaxy, Cipla, Aurobindo or Matrix sell in both developed countries and developing countries under their own brand name. Recently for example, Cipla has received US FDA approval for the marketing of Zidovudine (AZT) and the South-African FDA for the marketing of Efavirenz under license from Mercks, both medicines are antiretrovirals. Before, Aurobindo, Ranbaxy and Matrix received US FDA approval for the antiretroviral Didanosine (ddI) or AZT<sup>30</sup>.

All three countries have developed basic innovation capabilities in the form of re-engineering skills, but are on different rungs of the value-adder ladder. The value chain in pharmaceuticals runs as follows from the least knowledge/value added intensive product to

<sup>30</sup> Cf. <http://www.fda.gov/oashi/aids/viralsgeneric.html>.



the most knowledge intensive/value added product: (i) formulations; (ii) bulk drugs; (iii) active pharmaceutical ingredients (API); generics; bio-generics; (iii) dosage formulation; drug delivery system; (iv) new chemical entity; (vi) niche segment drug; (vii) broad therapeutic segment blockbuster. All three countries have developed innovation capabilities that enable them to manufacture formulations and all produce bulk drugs. However, Thailand and Brazil are still highly dependent on imports of API, generics and biogenerics. India has developed considerable innovation capabilities that enable it produce API, generics, biogenerics as well as new dosage formulation (e.g. Ranbaxy's once a day dosage for Ciprofloxacin; Dr. Reddy's Fluxentine 40mg tablets) and drug delivery system (e.g. Ranbaxy's oral release of Ciprofloxacin; Dr. Reddy's Fluxentine 40mg tablets). However, no developing country firm has to this date created a new chemical entity or new drug.

In the light of the above, one can clearly conclude, that in terms of catching-up as given by development of industrial competence, India is clearly in the lead, followed by Brazil, and finally by Thailand.

So what are the consequences of catching-up or not catching up?

With respect to national sovereignty, India is the only country to achieve self-sufficiency and technical independence to a large degree. Brazil produces only a few API and Thailand practically none, leading them to rely largely on imports, leading in turn to a trade deficit in the pharmaceutical sector. There is a negative relation between national autonomy in a sector and benefit to foreign multinationals in the corresponding country. Brazil with its large market and Thailand with small but growing market have benefitted foreign producers by providing them with markets for the imports of formulations and API from their mother countries.

A second consequence of catching-up is that the countries of the South have been able to help one another. Generic producers from India were able to supply other countries of the South like Brazil and Thailand, with products that were much cheaper than those offered by Western multinationals. In turn, emerging country and developing country markets enabled Indian firms not only to augment their profit but also to develop dynamic capabilities in manufacturing abroad and marketing, training them to aim at developed country markets. The advantages offered by Indian pharmaceutical firms were not only in terms of price but also in terms of dosage and delivery system innovations. For example, anti-AIDS drug cocktails developed by Cipla, Ranbaxy and Hetero not only brought about a tremendous price reduction in the global market of antiretrovirals (from about 150,000\$ per year per person to \$350 per year per person) but also reduced dosage from 12 tables to 2 tablets per day. Similarly, the development of a fixe-dose combination by Ranbaxy for patients suffering from both high blood pressure and high levels of cholesterol helped millions of patients around the developing world<sup>31</sup>.

Therefore, it is clear that catching-up supports national sovereignty and economic development of South. But this leads to another moot question. Why did the three countries, all of which had the same technological base at the end of World War II, catch up to different degrees by the millennium? This question becomes particularly relevant because all three countries, India, Brazil and Thailand enjoyed a period of process patent regimes, when local firms as second innovators could take over the market from foreign multinationals. However, this happened significantly only in India. Why?

Though no "sufficient conditions" have been identified for the creation of industrial capabilities in knowledge intensive sectors such as pharmaceuticals, a set of necessary

---

<sup>31</sup> Its NDDS product portfolio contributes to about 9% of its total turnover in India. See <http://www.ranbaxy.com/operations/operationregion.aspx?id=59&flag=>.

conditions for any developing country to catch-up in such sectors seems evident. First, there has to be an adequate base of skilled scientific labour, which means that the university and public research laboratories have to ensure the supply of a sufficient quantity and quality of scientists, who can generate knowledge and who can be employed by firms. Second, there has to be an adequate circulation of resources (information, labour, people and capital) between the research market where public laboratories are most active, the technology markets with both firms and public laboratories and the final product markets formed of manufacturing firms, so that there is an efficient transformation of knowledge into technology. Third, there must be sufficient incentives for private firms to invest in the creation of manufacturing capabilities and innovation. Fourth, there must be agents in the economy, the State, firms or financiers, who are willing to bear the costs and risks of innovation creation (Jolly and Ramani, 1996). Following this argument, we propose four factors to explain the catch-up positions of India, Brazil and Thailand: role of the State, role of the public sector and public-private cooperation, nature of market competition and incentives generated by IPR.

*(i) Role of the State:* Governments typically try to satisfy the first necessary condition through direct investment in the creation of qualified personnel through outlays in higher education and research. They attempt to facilitate the other conditions through appropriate regulation and industrial policy including IPR.

Though all three countries invested in higher education and research, it seems to have been most effective in India. Though it is often touted that the Indian Patent Act of 1970 infused life into the Indian pharmaceutical industry, it must be viewed simply as a vital drug administered to a dying person, who survives only if the essential organs are functioning in the first place, and dies otherwise. By 1970, thanks to the major investment of the government in the post-independence period, a network of universities and research institutions in the post-independence period was generating large pools of qualified labour in the form of chemists, pharmacists, engineers and managers available to work in pharmaceutical firms. This played a vital role in supporting the growth of the private pharmaceutical industry.

In terms of other policies facilitating industrial competence, one can cite the 'Generics Act' and the optimal and effective use of 'compulsory licensing' in Brazil that facilitated the strengthening of local Brazilian firms. The latter also supported the public health system. Whereas, the manner in which compulsory licensing is implemented in India, it enables them to export essential drugs to other developing countries but does not make a significant impact on the local health care system.

In an opposite sense, the engagement of the Thai State in the initiation of norms to promote safety (e.g. GMP, SMP) forced local firms to exit the market and fortified the market shares of foreign multinationals, even though it improved the quality of the medicines available.

*(ii) Role of public sector and public-private cooperation:*

In both Brazil and Thailand, the public sector organizations were either production or distribution units or both, complementing the private sector in terms augmenting the availability of medicines and their distribution to the patients. In India, strangely enough, the public sector organization designated for health care, 'The Indian Council of Medical Research (ICMR)' hardly played any role either in helping Indian firms or the Indian healthcare system. However the chemical laboratories of the 'Council of Scientific and Industrial Research

(CSIR)' played a crucial role in strengthening the capabilities of Indian firms through carrying contract research for them. The chemical laboratories researched, identified and created new process technologies at the laboratory scale, which they transferred them to firms with technological capabilities in scaling them up to pilot and plant scale.

*(iii) Size and composition of market under the process patent regime:*

Brazil and Thailand were strongly marked by the presence of foreign multinationals even during the period when they had a process patent regime. For instance, even in 1980, about 71% of the Brazilian market was supplied by foreign firms (Frischtak, 1989). Multinationals are more likely to form an implicit cartel with market sharing or mutual support for highly pegged prices, rather than engage in head to head competition.

India on the other hand had a number of pharmaceutical firms at the time of the promulgation of the process patent regime in 1972. Within, a decade it was clear that profits could be increased through technological innovations. Thus, the change in the patent regime initiated 'winner takes all' tournaments within the Indian market, whereby the first firm to commercialize the re-engineered product reaped in all the profits. Often the incremental technological innovations continued, with a second or third innovator improving upon earlier re-engineered products and grabbing the market share, lowering the prices even further and increasing consumer welfare. Thus, while firms competed to introduce innovations in Western markets in one shot technology races, that ended when the first innovator patented its product, in India, due to the process patent regime, firms continually introduced technological improvements lowering the cost of production, drug prices and increasing consumer welfare. A serious consequence of such dynamic technology races was that Indian drug producers faced continual gales of technological competition in which only the most diversified or the most technologically competent firms survived. Thus, the Indian pharmaceutical market became very dynamic and competitive.

*(iv) Impact of IPR*

The case studies reveal that having a weak IPR regime does not automatically guarantee catching-up as all three countries enjoyed a period of weak patent regimes, but they were not able to exploit this opportunity equally.

However, the impact of a stronger IPR regime on the behaviour of multinationals has been similar in the three countries. Article 7 of TRIPS stipulates that the "The protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations". Furthermore, Article 66-2 envisages that "developed country members will provide incentives to their firms and institutions to transfer technology to less developed countries. In other words, in return for putting in place an IPR system, developing countries expected to see an improvement in their access to new and innovative techniques and therapeutics, improves through a significant technology transfer and foreign direct investment towards their region. This has not been the case in any of the three countries. As the case studies reveal, this is because IPR is not the sole determinant of technology transfer being also dependent on other factors like a good business climate, infrastructural facilities, quality and quantity of labour supply and vested monopolistic interests.

*(v) Consequences of not having deep pockets*

As may be recalled, many Thai firms had to exit the market because they could not bear the costs of GMP adoption. In Brazil and Thailand, firms prefer not to invest on R&D as the returns to investment are not deemed to high enough, which in turn locks them into a lower level of innovative capabilities. Even, in the Indian case, when firms are striving to catch-up in terms of innovation, lack of finance constrains all but the top firms. In order to surmount their lack of funds to invest in R&D, Indian firms are trying to integrate in the global division of work, in the R&D projects of Western multinationals. New forms of collaboration are emerging such as licensing out of molecules discovered by Indian firms, joint R&D contracts and outsourced clinical trials. In the upstream stages of drug discovery they take the form of licensing out and contract R&D. In the downstream stages of drug commercialization they take the form of conducting clinical trials for the innovations of multinationals. NPIL has preferred to act as like a specialist supplier and is also more spread out than Wockhardt having activities involving contract manufacturing, R&D collaboration and clinical trials. Neither of the two firms is involved in licensing-out.

Finally, it may be recalled that catching-up involves two components: development of industrial competence and accessibility to medicines and healthcare. Though the focus of this paper has been on the former, it is worthwhile to cast an eye on the relative positions of the three countries with respect to the latter as summarized in table 6.

It shows that while India is much ahead of Brazil and Thailand in terms of its production and innovation capabilities, in terms of healthcare, it cuts a sorry figure with respect to the other two countries. Though prices of medicines and diagnostics are among the lowest in the world in India, the distribution of the same to the people needs to be improved. Dutta (2007) notes that in 2002 only seven countries in the world had lower public expenditures on health than India and they were Angola, Azerbaijan, Burundi, Iraq, Myanmar, Nigeria and Pakistan. Due to very limited coverage of insurance system (both social and private), along with low government expenditure, 75% of the health expenditures in India is paid out of the pockets of patients. On the other hand, in Thailand, almost 95% of the population is covered by social security. India has a very dismal record in comparison. Brazil is often hailed as a as a healthcare success story as it has improved some health indicators such as mortality rates (from 11 in 1980 to 5.6 per 1000 in 2001) and the immunization coverage has reached more than 95%. Although access to medicines is still a public health problem, Brazil has achieved good results especially with respect to the HIV/AIDS epidemic.

The above brief look clearly drives home the point, that creation of industrial capabilities and ensuring healthcare for all, are two different faces of the same coin of catching-up. The degree of catching-up on one aspect is not automatically correlated to the degree of catching-up on the other. Moreover, policies which promote one part of catching-up need not promote the other and this applies especially to IPR.

**Table 7: A comparison of Health care capabilities**

	India	Brazil	Thailand
Population (in million)	1109	188.7	64.7
GNI per capita	820	4730	2990
Pop. below 1\$ a day	34.03	7.5	3.2
Total expend. on health as % of GDP	5	8.8	3.5
Per capita total expend. on health	91.4	1519.7	293.3
Pub. health expend. as % of total health expend.	17.3	54.1	64.7
Private health expend. as % of total health expend.	82.7	45.9	35.3
Pub. health expend. as % of total pub. expend.	2.9	14.2	11.2
Physicians (density per 1000 population)	0.6	1.15	0.37
Pharmacists (density per 1000 population)	0.56	0.3	0.25
Availability of hospital beds (density per 1000 population) (in 1991)	0.8	2.7	2.2
% of HIV-infected people receiving ARVs	5.5	83	60
Source : WHO, World Bank, UNDP, UNAIDS, UNICEF, 2008.			

## 5. Conclusions

The present article attempted to examine the determinants of catching-up in the pharmaceutical sector through a detailed examination of three countries: India, Brazil and Thailand, in different stages of the catch-up process, with a focus on the role of IPR. It showed that while IPR plays an important role, other factors like State policy in terms of investment in public research, regulation, nature of market competition, public-private cooperation and consumer preferences modulate the final impact. Thus, having a weak IPR regime is not sufficient to assure catching-up and having a strong IPR or TRIPS, though not favourable to catching up, need not pose an unsurmountable obstacle if the other factors are correspondingly fine-tuned. In particular, it is necessary to examine how flexibilities embedded in TRIPS can be exploited in combination with other national investment, policy and regulation as well as international initiatives, to improve industrial capabilities. Multilateral South-South trade and cooperation initiatives can also play an important complementary role. Finally, the nexus between IPR and access to medicines is not so clear cut and there is a need for a better understanding of the conditions under which a stronger IPR regime will lead to a better access to medicines.

## References

Abbott F. M. (2006), Intellectual property provisions of bilateral and regional trade agreements in light of US Federal law, Issue Paper n°12, International Centre for Trade and Sustainable Development/United Nations Conference on Trade and Development, Genève.

Athreye, S., Kale, D. and Ramani, S.V. (2008), 'Experimentation with strategy and the evolution of dynamic capability in the Indian Pharmaceutical Sector', forthcoming in *Industrial and Corporate Change*.

Bekerman M. and P. Sirblin (2001), Static and dynamic impacts of Mercosur : the case of the pharmaceutical sector », *Cepal Review*, 75, December.

Bermudez J. A. Z. and M. A. Oliveira (2004), Intellectual property in the context of the WTO TRIPS agreement, WHO/PAHO Collaborating Center for Pharmaceutical Policies, National School of Public Health Sergio Arouca and Oswaldo Cruz Foundation, Rio de Janeiro, September.

Bermudez J. A. Z., M. A. Oliveira and E. Andrade de Oliveira (2004), « Expand access to essential medicines in Brazil : recent regulation and public policies », in Bermudez J. A. Z. and M. A. Oliveira (Eds), Intellectual property in the context of the WTO TRIPS agreement, WHO/PAHO Collaborating Center for Pharmaceutical Policies, National School of Public Health Sergio Arouca and Oswaldo Cruz Foundation, Rio de Janeiro, September.

Bermudez J., Epsztejn R., Oliveira M. A. and Hasenclever L. (2002), Access to drugs, the WTO TRIPS agreement, and patent protection in Brazil : trends, perspectives and recommendations to help find our way, MSF/DND Working Group.

Cassier M. and M. Correa (2006), « Intellectual property and public health : copying of HIV/AIDS drugs by Brazilian public and private pharmaceutical laboratories », *Electronic Journal in Communication and Innovation in Health*, Volume 1, Number 1.

Chaisse J. and S. Guennif (2007), "L'économie politique du brevet au Sud: variations indiennes sur le brevet pharmaceutique", *Revue Internationale de Droit Economique*, XXI, 2.

Chaudhuri, S. (2007), 'Is Product patent protection necessary in developing countries for innovation? R&D by Indian pharmaceutical companies after TRIPS', Indian Institute of Management, Calcutta.

Chequer P. (2007), Access to treatment and prevention : Brazil and beyond », Rapport, Ministère de la Santé brésilien, disponible sur [www.saude.gov.br](http://www.saude.gov.br).

Cohen J. C. (2000), Public policies in the pharmaceutical sector : a case study of Brazil, The World Bank, Latin America and the Caribbean Regional Office, Human Development Department, LCSHD Paper Series, n° 54, January.

Da Silva C. L. and A. Oliveira (2007), « Brazilian Industry policy after 1990 :focusing on the pharmaceutical industry », *Journal of Technology Management and Innovation*, Volume 2, Issue 3.

De Lemos Capanema L. X. (2006), A industria farmaceutica brasileira e a atuação do BNDES, BNDES Setorial, Rio de Janeiro, March, n°23.

Delgado Bastos V. (2005), *Innovao farmaceutica : padrao setorial e perspectivas para o caso brasileiro* », BNDES Setorial, Rio de Janeiro, n° 22.

Dhanarajan S., (2001), « The Impact of Patent Rules on the Treatment of HIV/AIDS in Thailand. Thailand Country Profile », *OXFAM GB*, march.

Febrafarma (2007), *Perfil do emprego e dos salarios na industria farmaceutica brasileira*, Estudos Febrafarma, available on [www.febrafarma.org](http://www.febrafarma.org).

Food and Drug Administration (1999), « Current Status and Practice in Pharmaceutical Regulations and Technical Requirements in Thailand », Report.

Frischtak C. R. (1989), *The protection of intellectual property rights and industrial technology development in Brazil*, the World Bank, Industrial and Energy Department, working Paper, Industry Series Paper n°13. September.

Gazette of India (2005), *The Patents (Amendment) Act (2005)*, 7 April.

Gehl Sampath, P. (2006), 'Indian pharma within global reach?', *UNU-Merit Working paper, 2006-031*, United Nations University. Maastricht

Greene, W. (2007), 'The Emergence of India's pharmaceutical industry and implications for the U.S. Generic Drug Market', *Office of Economics Working Paper, U.S. International Trade Commission*, Washington D.C.;

Guennif S. (2007), « Harmonisation globale des systèmes de brevet et impact locaux. Brevet et accès aux médicaments dans les pays en développement sous AADPIC et AADPIC plus », *Economie et Institutions*, à paraître.

Guennif S. and C. Mfuka (2003), « Impact of intellectual property rights on AIDS public health policy in Thailand », in Moatti and alii (eds) *Economics of AIDS and access to HIV/AIDS care : issues and challenges*, Edition de l'Agence Nationale de Recherches sur le Sida.

Guennif S. and C. Mfuka (2005), "L'accès aux traitements antisida en Afrique: une analyse de la stratégie de brevet des entreprises multinationales", *Mondes en développement*, "Institutions et santé dans les pays en développement", volume 3, n°131.

Hasenclever

ISPE (2006), "Country profile: a look at the pharmaceutical industry in Thailand", *The official journal of ISPE*, January/February, vol. 26, n°1.

Jolly, D. and Ramani, S.V. (1996) 'Technology Creation in the Biotechnology Sectors: The French Connection' *International Journal of Technology Management*, Special Issue on Access to Technological and Financial Resources for SME innovation, vol 12, no. 7/8, 830-848, (1996).

Kale, D. J. (2005), 'Re-developing a knowledge creation capability: Innovating in Indian pharmaceutical industry under TRIPS regime', unpublished PhD Thesis, The Open University, UK

Kale, D. J and Little, S. E (2007), 'From Imitation to Innovation: The Evolution of R&D capabilities and Learning Processes in the Indian Pharmaceutical Industry', *Technology Analysis and Strategic Management*. 19: 589-611.

Kuanpoth J. (2006), *Harmonisation of TRIPS-Plus IPR policies and potential impacts on technological capability. A case study of the pharmaceutical industry in Thailand*, International Centre for trade and Sustainable Development (ICTSD), regional Research Agenda.

Médecins Sans Frontières (2007), *Untangling the web of price reductions: a pricing guide for the purchase of ARVs for developing countries*, 10<sup>th</sup> édition, July.

Mfuka C. (2002), "Accord ADPIC et brevets pharmaceutiques – Le difficile accès des pays en développement aux médicaments antisida", *Revue d'Economie Industrielle*, n°99, 2<sup>ème</sup> trimestre, pp. 191-214.

Ministry of public health and the National health security office (2007), « Facts and evidences on the 10 burning issues related to the government use of patents on three patented essential drugs in Thailand », Document to support strengthening of social wisdom on the issue of drug patent, February.

Oliveira M. A., G. Costa Chaves and R. Epsztejn (2004), « Brazilian intellectual property legislation », in in Bermudez J. A. Z. and M. A. Oliveira (Eds), *Intellectual property in the context of the WTO TRIPS agreement*, WHO/PAHO Collaborating Center for Pharmaceutical Policies, National School of Public Health Sergio Arouca and Oswaldo Cruz Foundation, Rio de Janeiro, September.

Oliveira M. A., J. A. Z. Bermudez, G. Costa Chaves and G. Velasquez (2004), « Has the implementation of the TRIPS agreement in Latin America and the Caribbean produced intellectual property legislation that favours public health », *Bulletin of the World Health Organization*, 82(11), November.

Oliveira M. A., J. A. Z. Bermudez, R. Epsztejn, G. Costa Chaves, R. L. Ferreira and M. T. Oliveira (2004), « Pharmaceutical patent protection in Brazil: who is benefiting », in Bermudez J. A. Z. and M. A. Oliveira (Eds), *Intellectual property in the context of the WTO TRIPS agreement*, WHO/PAHO Collaborating Center for Pharmaceutical Policies, National School of Public Health Sergio Arouca and Oswaldo Cruz Foundation, Rio de Janeiro, September.

OPPI, 'OPPI Pharmaceutical Compendium', Mumbai: Organisation of Pharmaceutical Producers of India, Volumes 2001, 2004.

Oxfam (2004), *Free Trade Agreement between the USA and Thailand threatens access to HIV/AIDS treatment*, Oxfam Briefing Note, July.

Oxfam (2006), *Public Health at risk. A US Free Trade Agreement could threaten access to medicines in Thailand*, Oxfam Briefing Paper, April.

Pradhan, J. (2007), 'New Policy Regime and Small Pharmaceutical firms in India', *Working Paper 2007/02 of the Institute for Studies in Industrial Development*, New Delhi;

Ramani, S. V. (2002), 'Who's interested in biotechnology: R&D strategies, knowledge base and market sales of Indian biopharmaceutical firms', *Research Policy*. 31: 381-398.

Ramani, S. V. and Maria, A. (2005), 'TRIPS and its possible impact on the biotech based segment of the Indian pharmaceutical industry', *Economic and Political Weekly*. Feb 12-18: 675-683.



Ramani, S. V., and Putz, C. (2001), 'Resources, performance and strategy: a statistical examination of the integration of biotechnology in the Indian pharmaceutical sector', *International Journal of Biotechnology*. 3: 374-390..

Rossi F. (2006), « Free trade agreements and TRIPS-plus measures », *Int. J. of Intellectual property management*, Vol. 1, n°1, pp. 150-172.

Supakankunti S., Janjaroen W.S., Tangphao O., Rahanawijnasini S., Kraipornsak P., Pradithavanij P. (2001), « Impact of the World Trade Organization TRIPS Agreement on the Pharmaceutical Industry in Thailand », *Bulletin of the World Health Organization*, 79(5).

Sweet C. (2007), « Regulating the Tigers ; the institutional dynamics of Indo-Brazilian trade reflections from the pharmaceutical sector », *ELSNIT Conference*, Barcelona, Institutional dimensions of integration and trade.

UNCTAD/ICTSD (2004), *Resource book on TRIPS and development : an authoritative and practical guide to the TRIPS agreement*, UNCTAD/ICTSD capacity building on IPRs, disponible sur [www.iprsonline.org/unctadictsd/ResourceBookIndex.htm](http://www.iprsonline.org/unctadictsd/ResourceBookIndex.htm).

WHO (2008), *Improving access to medicines in Thailand : the use of TRIPS flexibilities*, Report of WHO Mission, Bangkok.

Wibulpolprasert S. (2000), « Mobilization of Domestic Resources for Essential Drugs Developing Countries : Case Study for Thailand », MOPH, Thailand.

Wogart J. P. and G. Calcagnotto (2006), « Brazi's fight against AIDS and its implications for global health governance », *World Health & Population*, January.

World Bank (2005), *Expanding access to antiretroviral treatment in Thailand. Achieving treatment benefits while promoting effective prevention*, World Bank, Human development sector, East Asia and Pacific Region, Washington DC, December.

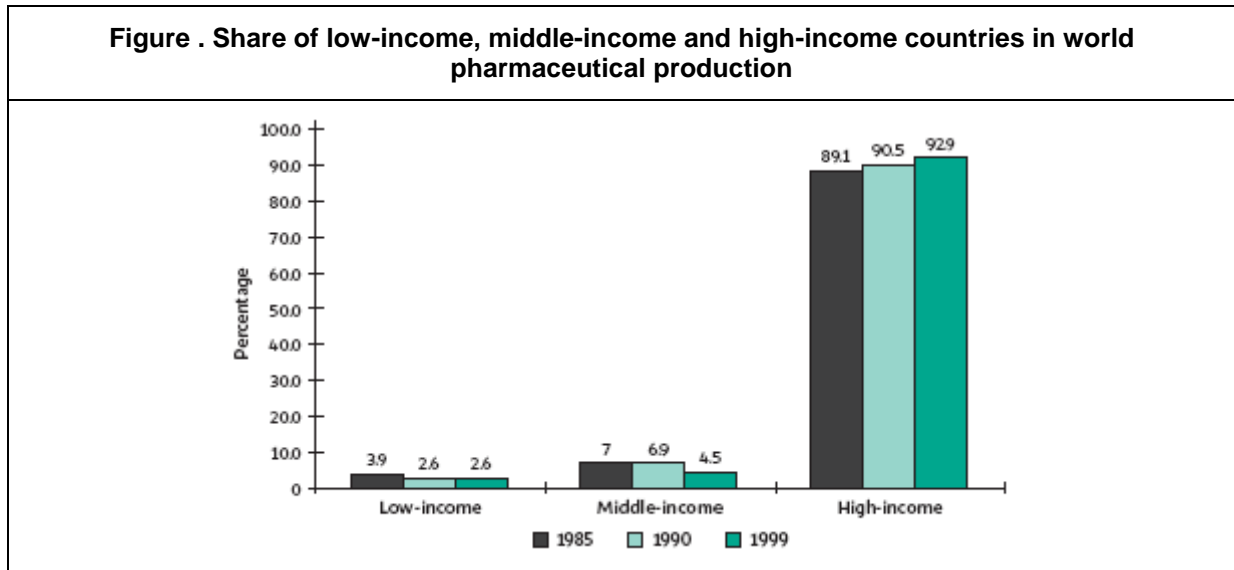
World Health Organization (1999), *Multilateral Trade Agreements and their Implications on Health, Report of a Regional Consultation*, Bangkok, Thailand, 16-18 August.

World Health Organization (1999), *Multilateral Trade Agreements and their Implications on Health, Report of a Regional Consultation*, Bangkok, Thailand, 16-18 August.

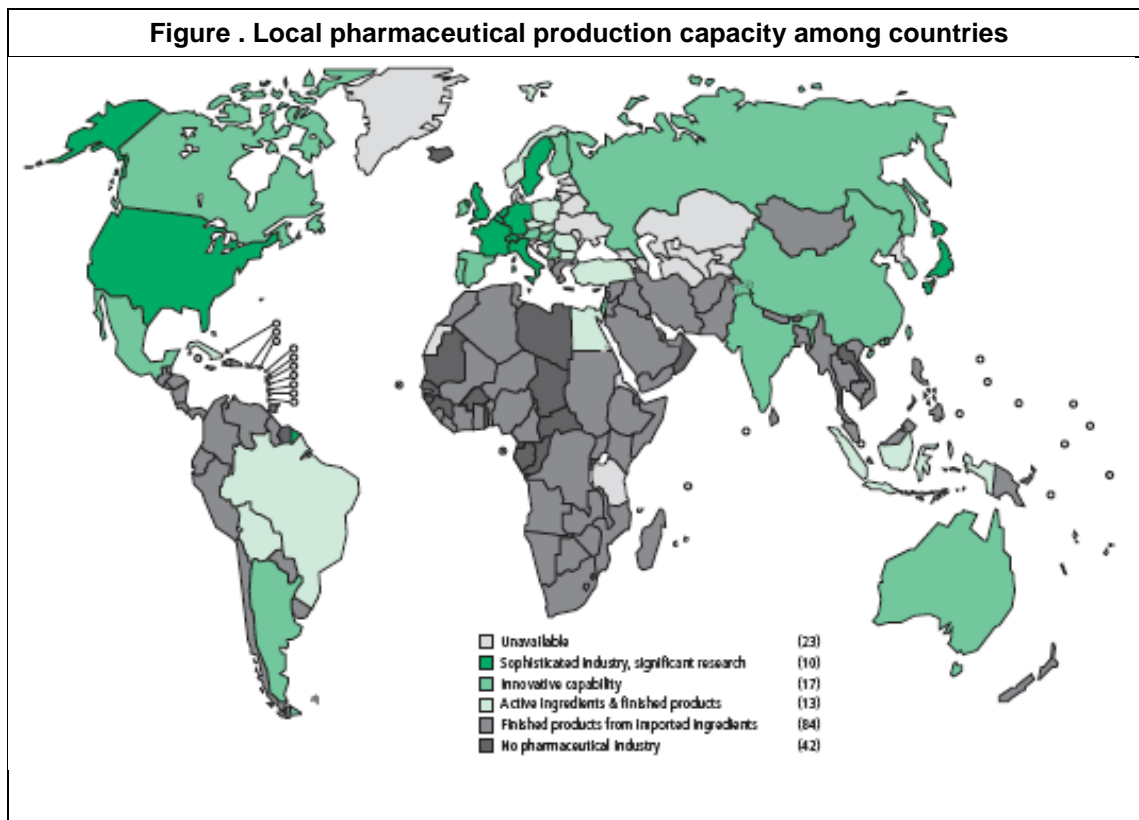
World Health Organization (2004), *The World medicine situation*, WHO, Geneva.

World Trade Organization (1994), *Trade-related aspects of intellectual property rights*, available on [www.wto.org](http://www.wto.org).

Appendix



Source: WHO estimates based on data reported by UNIDO, OECD, 2004.



Source: WHO, 2004.