Policy as a driver of economic growth: historical evidence from the Indian pharmaceutical industry

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Sound implementation of a well-crafted policy decision allows for technological innovation and sectoral economic proliferation. The rise of the Indian pharmaceutical sector is a classic example in this context. This article aims to trace the evolution of the Indian pharmaceutical industry, highlighting the robust policy decisions favouring the proliferation of the pharmaceutical industry. The national linkages in the form of institutional capacity building and technological improvements have also been focused upon.

Keywords: Health policy, Indian pharmaceutical industry history, open source, science policy history, science and technology policy.

THE Indian pharmaceutical sector is a leading player in the global pharmaceutical sector and among the fastest developing industries in the Indian economy. With a market value of INR 2.5 lakh crore (note 1), the Indian pharmaceutical sector ranks third globally in terms of drug market by volume and accounts for nearly 2.4% of the global pharmaceutical industry in value terms, and 10% in volume terms. India is a leading exporter of generic drugs to developing countries, accounting for nearly 20% of the global generic exports[1].

In 1947, when India gained independence, the value of the pharma sector was a meagre INR 10 crore[2]. The rise of Indian pharma (note 2) from a non-existent sector to a world leader is an outcome of legislative reforms, expansion of technological capacities, value addition through mergers and acquisitions, and most importantly, strategizing to position itself as the leader of reverse engineering patented drugs by innovative process development.

This review aims to trace the evolution of policy decisions that were critical in developing the India pharma sector and is divided into five major epochs namely:

- Epoch I (pre-independence (before 1947))
- Epoch II (post-independence (1947–1970))
- Epoch III (post 1970–1991)
- Epoch IV (post Economic Liberalization, 1991–2005)
- Epoch V (post product patent amendment of 2005 – National Intellectual Property Rights Policy (NIPR) of 2016)

Epoch I (pre-independence)

India is rich in traditional knowledge that spans across centuries. Ayurveda, Unani, Siddha, etc. once the leading forms of medical systems, continue to hold strong presence as leading forms of alternative medicine.

However, the dawn of colonization in the early 18th century marked a deviation from traditional knowledge, exposing India to modern science and its applications. This deviation was mainly fuelled by British interest in merely expanding the scope of their own market's size and value. In his essay, 'The Place of India in the Empire (note 3)', India's viceroy Lord Curzon, emphasized the strategic role played by India in strengthening British trade[3].

India being *Jewel of the Empire* meant that the British had to deliver upon governance to maintain a firm stronghold and ensure smooth trade and economic growth. It is estimated that almost 20% of British exports was to India. The trade-off for resource utilization was manpower and capacity development, necessitating massive transitions from traditional knowledge towards western scientific and medical knowledge. A scientific landmark that needs to be acknowledged in this transition is the 'great trigonometric survey' of India.

Great Trigonometric Survey of India

India's first brush with application of modern science came with the 'Great Trigonometric Survey' in 1802 under William Lambton. The survey, aimed at collecting geographical knowledge of the Indian sub-continent, using a thorough scientific approach, saw the use of telescopes, thermometers, chronometers and various other geodetic methods[4]. The survey also led to the establishment of various societies and observatories, beginning with the Madras observatory in 1792. Further expansion of the survey led to the establishment of the Palaeontological

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Survey (1837), Zoological Survey (1847), Geological Survey of India (1851), India Meteorological Department (1875), Botanical Survey of India (1890), etc. These surveys were a step towards strengthening western scientific education in India. The role of Indians in these surveys, though was that of subordinates, demanded western learning and modern scientific inquisitiveness.

One of the earliest evidence of modern scientific learning is the compilation of the *Materia Medica of Madras* by Mohideen Sheriff Khan Bahadur in 1891. The compilation described drugs corresponding to the Pharmacopoeia of India and according to natural orders of plants producing them. It listed nearly a thousand drugs along with the disease for which they could be prescribed with an index of the botanical or scientific names and synonyms in different languages. The collection consists of 9 volumes from British India, dating from 1867 to 1903 with extensive research on hemp and opium usage, cultivation of cinchona trees, reports from Nilgiri plantations and use of chloroform in anesthesia[5]. This became the colonial addendum to the British Pharmacopoeia.

Education and healthcare

The shift in education and healthcare sectors aided the shaping of the Indian pharmaceutical industry. The creation of centres of higher learning gave Indians access to western science and inculcated scientific temper. The turning point came as the historic *Minutes on Indian Education* of 1835 by Lord Thomas Macaulay who urged the need for western learning in primary and secondary institutions, thus departing from India's traditional form of education[6]. The earliest institutional setups that have contributed heavily towards higher intellectual and institutional capacity building, include the Hindu College (1817, Calcutta), Calcutta University, Bombay University and Madras University (all in 1857). The Indian Universities Act of 1904, the first policy implemented for higher education enabled universities to transition from mere affiliating and examining bodies to undertaking teaching and research. As a result, by the end of the nineteenth century, there were five major universities, including two at Allahabad and Lahore, and 170 colleges. Between 1916 and 1929, thirteen new universities were set up with courses in chemistry, mathematics, algebra, botany, zoology and geology. The need for a scientific ecosystem to fuel nation building was felt. Eminent among these institutes are shown in Table 1.

This not only shifted the focus from Indian traditional knowledge-based medical system to western medicine, but also resulted in India's ability to adapt to and evolve the reverse engineering process of drug manufacture.

The healthcare sector received rigorous attention of the colonial government due to the risk of exposure to incurable tropical diseases that British troops faced in India. A medical system framework was created to address this. The first known medical service was established in 1764 in Bengal. In 1896, the Indian Medical Services was established. The Calcutta Medical College established in 1853 was the first institute of western medicine in Asia. The focus was on building hospitals and dispensaries along with delivery of public health services[7]. An example of the public health service was the inoculation (vaccination) against smallpox, first started in 1827 in Bombay[8]. All these led to: (i) Vaccines Act of 1880 (Compulsory vaccination of children); (ii) Birth and Death Registration Act of 1873; (iii) The Epidemics Act of 1897; (iv) Madras Public Health Act of 1939; (v) Drugs and Cosmetics Act of 1940 (drugs were made under Government control for the first time)[9].

A major milestone in the Indian public health system was the setting up of the Health Survey and Development Committee in 1946 led by Joseph Bhore. The committee was to assess the then existing healthcare landscape and suggest recommendations. The committee looked at public health, medical relief, professional education, medical research and industrial health. The major impact of the committee's recommendation was the setting up of a National Health Policy. The first National Health Policy was realized in 1983, the second in 2002. The third was launched in 2017.

India has been governed by various patent laws during the course of her history, notably the Act VI of 1856, and The Patterns and Designs Protection Act of 1872. In 1911, the Indian Patents and Design Act was executed. During this period, only British companies operated the pharmaceutical sector in colonial India, a notable exception being the Bengal Chemical and Pharmaceutical Works established by P. C. Ray in 1901. This act, which replaced all previous laws, created for the first time a system of patent administration in India under the direction of the Controller of Patents. The 1911 Act which provided both product and process patents, gave priority to an applicant for an Indian patent, if the applicant had filed for the patent in the United Kingdom in the previous twelve months. The patent was applicable for 10 years and extendable up to 6 years[10]. The process of formulation could be mentioned in passé, thereby, averting any mechanism of re-engineering or reverse engineering the process. The act acted as a major deterrent to the growth of the indigenous pharmaceutical industry.

Epoch II (post-independence (1947 to 1970))

August 1947 marked the end of the colonial rule in India and the beginning of the uphill task of nation building. The Indian economic charter was divided into phases of five years, known as the five-year plans. It was in the second five-year plan that it was recognized that India was reeling under high imports in almost all sectors.

Table 1 Education institutions

Name	Place	Year
Haffkine Institute	Bombay	1899
Imperial Agricultural Institute	Pusa (Bihar) [Now in New Delhi]	1903
Central Research Institute for Medical Research (including the Malaria Unit)	Kasauli	1905
Forest Research Institute	Dehradun	1906
Pasteur Institute of Southern India	Coonnoor	1907
J.C. Bose Research Institute	Calcutta	1917
Cotton Technological Laboratory	Bombay	1924
Institute of Plant Industry	Indore	1924
Indian Lac Research Institute	Ranchi	1925
Indian Statistical Institute	Calcutta	1931
All India Institute of Public Health and Hygiene	Calcutta	1934

Import dependence was highest in the pharmaceutical sector; 38 of 197 companies had more than 50% foreign equity and 8 of 17 were wholly owned by foreign subsidiaries in India[11]. The need for import substitution by strengthening technological capability, reducing foreign dominance, building indigenous capacity, encouraging small scale industries, preventing concentration of economic power, reducing income inequalities and controlling of the economy by the state[12] was envisaged, thereby steering the nation towards self-reliance and high growth rate. The policy interventions to strengthen the pharmaceutical sector were an outcome of the recommendations of the following committees which were later formulated into various acts and amendments including the patent act of 1970: (i) Justice Tek Chand Committee report 1949 (ref. 13); (ii) Pharmaceutical Inquiry report of 1954 (ref. 14); (iii) Ayyangar Committee report of 1959 (ref. 15); (iv) The Committee on Drugs and Pharmaceutical Industry of 1975 (ref. 16).

Justice Bakshi Tek Chand Committee Report (1949)

The committee was constituted under the Chairmanship of Justice (Dr) Bakshi Tek Chand in 1949, to review the patent law in India with a view to counter the misuse or abuse of patent monopolies in India by enacting provisions for compulsory licensing. The main recommendations of the committee were:

Any interested person may apply for a compulsory license or revocation of the patent on any of the following grounds, namely (i) Patented invention, being capable of being commercially worked in India, is not being commercially worked therein to the fullest possible extent; (ii) Demand for the patented article in India is not being met to an adequate extent by imports or on reasonable terms; (iii) Commercial working of the invention in India is being prevented or hindered by the importation of the patented articles; and (iv) The refusal of the patentee to grant a license or licenses on reasonable terms, whereby the commercial or industrial activities in India are prevented or hindered.

The Government accepted these recommendations resulting in the amended sections 22, 23 and 23A to 23G of the Indian Patents and Designs Act, 1911.

Pharmaceutical Inquiry Report (1954)

The committee report laid bare the state of drug manufacture and role of foreign firms in the country. It revealed that foreign companies were merely using the Indian front to mainly process imported bulk pharmaceuticals into final formulations. Setting the tone to reduce import dependence and promote indigenous firm development, the committee recommended the following: (i) For foreign firms to operate in India they would have to start manufacturing units even if it were for basic chemicals and improve the quality of drugs. (ii) Reduction of import duties on raw materials and intermediaries required by the industry. (iii) Encouraging new units of manufacturing either under the Government aegis or under the private sector. (iv) Expansion of the scale of production units by easing the license conditions, particularly for small-scale units. (v) Implementing a system of fair trade prices so as to avoid existing price-cut and centralizing the drug control by bringing it under the Drug Controller (India).

Ayyangar Committee report (1959)

The Ayyangar Committee report, a landmark in the patent law system in India, triggered India to exercise the Patent Amendment Act of 1970, which went on to become the single most important policy tool to shape the Indian pharmaceutical sector. Led by Justice Rajagopala Ayyangar, the committee in 1957 reviewed and amended the prevailing patent laws so as to cope with the industrial demands at the time. The report was submitted in 1959 and the major outcome was the provision of process patenting of drugs as against product patenting, based on the need for medicines for the poorer sections of society. Based on the recommendations of the committee, a Bill

(note 4) was introduced in the Parliament in 1965, which was passed in 1970, enforced in 1972, and came to be the prevailing Patents Act.

The Committee on Drugs and Pharmaceutical Industry (Hathi Committee Report) (1975)

The Committee on Drugs and Pharmaceutical Industry (Hathi Committee) of 1975 was formed to study the state of the pharmaceutical sector and suggest recommendations for improving technology and quality of drugs, reduce the price of essential drugs and most importantly promote the small-scale sector to play a vital role in manufacturing. The report identified 116 essential drugs. Its major recommendations were: (i) Establishing of a National Drug Authority (NDA) to ensure production and distribution of essential drugs to the poorest of the poor; (ii) Strengthening the role of public sector units for the entire drug development pipeline; from R&D to production to distribution.

The Industrial Policy Resolution of 1956 was amongst the basic economic policy frameworks and provided the basis for industrial development in India. The policy mandated industrial licensing for drugs and pharmaceutical companies. Pharmaceuticals were among the 12 industries to be put in Schedule B of the policy, allowing participation of both the public and private sectors. Despite persistent efforts, the period was still marked by domination by foreign players and their subsidiaries.

Epoch III (post 1970–1991)

Post-independence, India was in the overdrive to establish its industries and attain self-reliance while promoting indigenous sectors. The technological learning curve in the pharmaceutical sector was no different. The global scenario, meanwhile, was shifting towards creating synthetic and semi-synthetic chemicals in drug research. Capitalizing on this shift was easy for India given its strong pedagogy in chemistry. Though India was heavily reliant on Russian know-how for setting up drug manufacturing units, certain major policy instruments led to a change in the Indian pharmaceutical sector. These were: (i) The Drug Price Control Orders (DPCO); (ii) The Patent Act of 1970; (iii) The Monopolies and Restrictive Trade Practices Act (MRTP) of 1969; (iv) The Foreign Exchange Regulation Act (FERA) of 1973.

DPCO[17]

The drug policy in India was shaped as a direct result of the recommendations of the Hathi committee report. Multinational Companies (MNCs) used India as a front to assemble formulations without promoting manufacturing or R&D. By keeping the prices of non-essential drugs low and prices of essential drugs high, MNCs had monopolized the pricing of drugs in India. Addressing the concerns over the growing monopoly of MNCs over essential drugs, a series of price control regimes were notified from time to time, through various orders in the country, based on different principles. To state a few, these were: (i) The Drug Price Control Orders of 1966; (ii) The Drug Price Control Order of 1970 – issued under the 'Essential Commodities Act 1955 by declaring drugs to be essential commodities under the EC Act, 1955; (iii) Thereafter the Drug Price Control Order of 1978, Drug Price Control Order of 1979 and Drug Price Control Order of 1987 were issued following the declaration of the Drug Policy in 1986.

All these policies were broadly based on the principle of effecting control over prices of essential drugs, and later bulk drugs, as well as availability of drugs while at the same time attending to the requirements of the indigenous industry for growth, cost effective production, innovation and strengthening of capacity. The DPCO came up with a four-fold category classification of drugs, namely life saving, essential, less essential and non-essential.

The DPCO regulated drug prices by allowing marked-up prices, inclusive of profits, by 40% for life saving drugs, by 55% for essential drugs and by 100% for less-essential drugs. Supplementary Table 1 highlights the impact of the DPCO on the shift in trend of drug manufacture. The DPCO thus brought nearly 347 drugs under price control. As per the 1994 Policy, a list of 74 bulk drugs were identified, and formulations based on these (numbering about 1577) were brought under price control. Under the latest DPCO 2013, the prices of 348 drugs appearing in the National List of Essential Medicine (NLEM 2011) covering around 628 formulations have been brought under the purview of price control.

The Monopolies and Restrictive Trade Practices Act (MRTP) of 1969

In the late 1960s, following the report of the Monopolies Inquiry Commission (1964) and the reports of Hazari (1966) and the Industrial Licensing Policy Enquiry Committee (1969) (ref. 18), which reviewed the industrial licensing system, the government concluded that the existing licensing rules were unable to control the monopoly and concentration of economic power in a few hands[19]. As a result, the Monopoly and Restrictive Trade Practices Act (MRTP Act) was passed in 1969 to check the expansion of large industrial houses with gross assets exceeding INR 20 crores in interlinked undertakings or of dominant undertaking with assets of more than INR 1 crore.

Foreign Exchange Regulation Act (FERA) of 1973

The enactment of the Foreign Exchange Regulation Act (FERA) in 1973 further restricted foreign equity holding, which had to be diluted to a maximum of 40% of the total holdings, except in the case of core sector industries. The Industrial Licensing Policy, however, included drugs and pharmaceuticals in the list of core industries, which allowed both MRTP and FERA companies to participate in the growth of the industry. The identification of high-priority industries allowed the act to push the import-substitution scenario in India. Companies that were involved in using high-end technology were given relaxation of 74% foreign share. As the pharmaceutical sector was identified as a high-priority sector, most companies had to be involved in high-end manufacturing. The two conditions the companies had to meet were: (i) Non-associated formulators had to be supplied 50% of the bulk manufacturing. (ii) The value of bulk drug formulation in own manufacturing should not exceed 1 : 5; (iii) This criterion allowed for restricting captive consumption.

FERA was repealed in 1999 and gave way to the Foreign Exchange Management Act (FEMA). The FEMA[20] was an Act that was to 'consolidate and amend the existing law relating to foreign exchange with the objective of facilitating external trade and payments and for promoting the orderly development and maintenance of foreign exchange market in India'.

Patent Act of 1970

The Patent Act of 1970 effectively repealed the Patents and Design Act of 1911 and: (i) Granted only Process Patents for all chemical substances including pharmaceuticals, (ii) Granted the patent for a period of 7 years (down from 16 years) from the date of filing the patent or 5 years from the date of sealing the patent (whichever is lower). (iii) Granted patents only for *New* substances manufactured in India.

The 1970 Patent Act also introduced the licensing agreements, viz. Compulsory Licensing and Licensing of Right. Under Compulsory Licensing, a patent still under protection could be sought by a producer, if the cost of the product is too high or the product is unavailable in the producer's country. Under Licensing of Right, any person could acquire the technological knowledge from the patentee after arriving at a mutually conclusive agreement. These practices allowed more players to enter the pharmaceutical market, thereby increasing market competition and driving drug prices to a lower cost. Section 3 of the act provided special provisions applicable to patenting of pharmaceuticals and chemical products. This section provided the definition of *What are not inventions*: 3(c) Mere discovery of a scientific principle or the formulation of an abstract theory or discovery of any living thing or non-living substance occurring in nature; 3(d) Mere discovery of a new form of a known substance which does not result in the enhancement of the known efficacy of that substance or mere discovery of any new property or new use for a known substance or of the mere use of a known process, machine or apparatus unless such known process results in a new product or employs at least one new reactant; 3(e) A substance obtained by a mere admixture resulting only in the aggregation of the properties of the components thereof or a process for producing such substance; 3(i) Any process for the medicinal, surgical, curative, prophylactic diagnostic, therapeutic or other treatment of human beings or any process for a similar treatment of animals to render them free of disease or to increase their economic value or that of their products; 3(j) Plants and animals in whole or any part thereof other than micro organisms but including seeds, varieties and species and essentially biological processes for production or propagation of plants and animals.

Impact of Patent Act, 1970

The immediate effect of the Patent Act, 1970 was seen in the number of patent applications filed. In 1978–79 the patent applications filed in India fell to 1010 from nearly 4200 in 1968. However, the number of domestic firms that entered generic drug manufacturing dramatically increased, thereby ensuring that the prices of medicines effectively remained low and affordable. Table 2 shows a relative look at the percentage of market shares of MNCs (wholly owned or subsidiaries) and Indian companies, highlighting the impact of the Patent Act, 1970 (refs 21, 22).

Role of public sector

Prior to independence, the role of indigenous firms was limited. In 1901, Acharya P. C. Ray set up the Bengal Chemicals and Pharmaceutical Works (BCPW); a production unit for simple medical formulations from plant and animal tissues. This set the trend for establishing domestic production units. BCPW was followed by

Table 2. Market shares of MNCs versus Indian companies

Year	MNCs (%)	Indian companies (%)
1952	38	62
1970	68	32
1978	60	40
1980	50	50
1991	40	60
1998	32	68
2004	23	77

Source: Ref. 21.

Table 3. Domestic firms and institutions and their contributions[23]

Time period	Institutions and domestic firms	Production portfolio	Production levels
1900–1905	Haffkine Institute, Mumbai Central Research Institute, Kings Institute, Pasteur Institute, BCPW	Malaria, typhoid, cholera, vaccines and sera	Nil
1905–1920s	Alembic Chemical Works, Bengal Immunity	Chemicals like aspirin and barbituates	NA
1920–1930s	Unichem, Chem Pharma, Indo Pharma, Indian Process, Chemical Laboratory	Quinine salts, urea-stibamine, bio-chemicals and other synthetic products	NA
1930–1940s	CIPLA, Calcutta Chemicals, Standard Pharmaceuticals, East India Pharmaceuticals, Zandu Pharmaceuticals	Anesthetics, tetanus-antitoxins, anti-dysentry, anti-leprotic, alkaloids, chemotherapeutics, colloidal preparations.	13–15% of the demand in 1939

Table 4. List of indigenously developed drugs[25]

Drug	Year	Use	Institution
Urea stibamine	1921	Kala-azar	School of Tropical Medicine, Calcutta
Methaqualone	1956	Non-barbiturate hypnotic	Regional Research Laboratory (RRL) (note 5), Hyderabad
Hamycin	1961	Anti-fungal	HAL, Pune
Centimizone	1972	Anti-thyroid	CSIR-CDRI, Lucknow
Tromaril	1980	Anti-inflammatory	RRL, Hydearbad
Isaptent	1985	Cervical dilator	CSIR-CDRI, Lucknow
Guglipid	1986	Hypolipidaemic	CSIR-CDRI, Lucknow
Centbucridine	1987	Local anesthetic	CSIR-CDRI, Lucknow
Centbutindole	1987	Neuroleptic	CSIR-CDRI, Lucknow
Centchroman	1991	Nonsteroidal oral contraceptive	CSIR-CDRI, Lucknow
Azidothymidine	1993	Anti-Retroviral	CSIR-IICT, Hyderabad
Chandonium iodide	1994	Neuro-muscular blocking agent	CSIR-CDRI, Lucknow, Punjab University
Centpropazine	1996	Anti-depressant	CSIR-CDRI, Lucknow
Arteether	1997	Anti-Malarial	CSIR-CDRI, Lucknow
Standardised Brahmi extract	1997	Herbal remedy for memory improvement	CSIR-CDRI, Lucknow

Alembic Chemical Works (1907) and Bengal Immunity (1919). The research institutes established worked mostly in the area of malaria, tuberculosis and vaccines (Table 3)[23]. Over the next few decades, various small-scale and large-scale domestic production units were established like Indo Pharma, Unichem, Chem Pharma, Chemical Industries and Pharmaceutical Industries (CIPLA), Calcutta Chemicals, Zandu Pharmaceutical Works, etc. The domestic industry saw a shift in production from aspirin and quinine salts to synthetic drugs, chemotherapeutics, alkaloids, etc.[22], thus highlighting the progress of domestic pharmaceutical firms and research institutions towards self-reliance and self-sufficiency to meet the growing demand for affordable drugs.

In 1954, with a plant at Pimpri, Pune, the Hindustan Antibiotics Limited (HAL) became the first public sector drug company to be set up in India. In 1961, the Indian Drugs and Pharmaceuticals Limited (IDPL) was set up with the primary objective of achieving self-sufficiency in essential life-saving drugs and medicines.

HAL and IDPL were vital in steering the domestic production of bulk drugs and brought in a wave of technological-capacity enhancement, technology transfer, innovation and knowledge-network building. HAL and IDPL were production units for streptomycin, antibiotics, sulpha drugs, etc. Along with the public-sector firms, various research institutes were also instrumental in developing new drugs in India.

Among the research institutes, National Chemical Laboratory (NCL), Pune, Central Drug Research Institute (CDRI), Lucknow, Indian Institute of Chemical Technology (IICT) in Hyderabad, etc. have developed process-technologies for production of various drugs (Table 4), which are widely used by large-scale and small-scale pharmaceutical companies[24,25].

Epoch IV (Post economic liberalization of (1991–2005))

Reeling under the exceptional burden of Balance of Payments (BoP) crisis, India in 1991 launched massive economic reforms, stepping into the era of globalization[22]. The new economic reforms propelled market liberalization synergizing with the world economy. This also marked the end of the 'License-Raj' (note 6), thereby allowing foreign players more freedom in the Indian market, while creating leverage for domestic players and, allowing market competition to drive product excellence.

While India was jostling with her own internal reform-driven economic reconstruction, the world was adapting to a new-trade order, the TRIPS (Trade Related-Aspects of Intellectual Property Rights). The TRIPS agreement was a resultant trade agreement at the 1994 General Agreement on Trade and Tariffs (GATT)'s Uruguay round of negotiations. The GATT paved the way for a new order in world trade, i.e. The World Trade Organisation (WTO). TRIPS was adopted by most of the signatory member states of the WTO but was in direct conflict with the Indian Patent Act, 1970. The TRIPS (Article 28) conferred product patent rights (in context of drugs) exclusively to the producer for a period of 20 years[25]. It was pertinent for India to join the WTO. In 1995, post-economic liberalization and while moving into globalization, India joined WTO. As a binding, India had to adopt the TRIPS agreement. Provisioning this adoption, the Indian Patent Act saw three landmark amendments namely Patent (Amendment) Act 1999 and Patent (Amendment) Act 2002, Patent (Amendment) Act 2005.

In 1999, India finally allowed transitional filing of product patents to be implemented with effect from 1 January 1995 to 2005. WTO required India to set up a 'mailbox' wherein companies could file patents from 1995. The outcome of this act saw many foreign companies file for patent applications, with as many as 9000 companies filing for patent protection of their drugs. Roche (Switzerland) became the first company to win a patent application for its Hepatitis-C drug, Pegasys. The TRIPS agreement also required the provisioning of Exclusive Marketing Rights (EMRs) to certain products that are subject to mailbox applications[27].

The Patent Amendment Act 2002

The 2002 Patent amendment was of significance as it introduced Section 104A, which outlined *The Burden of Proof* clause in case of infringement:

'In any suit for infringement of a patent, where the subject matter of patent is a process for obtaining a product, the court may direct the defendant to prove that the process used by him to obtain the product, identical to the product of the patented process, is different from the patented process if

- The subject matter of the patent is a process for obtaining a new product; or
- There is a substantial likelihood that the identical product is made by the process, and the patentee or a person deriving title or interest in the patent from him, has been unable through reasonable efforts to determine the process used:
  - Provided that the patentee or a person deriving title or interest in the patent from him, first proves that the product is identical to the product directly obtained by the patented process.

The Patent Amendment Act (2005)

The 2005 amendment ensured the implementation of three very crucial sections, namely: (i) Deletion of Section 5 of the act; (ii) Amendment of Section 3(d); (iii) Removal of Chapter 4A.

Section 5 of the Act prohibited patenting of any food, drugs, medicines and chemical substances. This was the major highlight of the change of the Act, putting it in direct conformity with the TRIPS.

The amended Section 3(d) now reads as:

> 'The mere discovery of a new form of a known substance which does not result in the enhancement of the known efficacy of that substance or the mere discovery of any new property or new use for a known substance or of the mere use of a known process, machine or apparatus unless such known process results in a new product or employs at least one new reactant.'

Chapter 4 dealt with the granting of EMRs. Under Article 70(9) of the TRIPS, EMR is subject to two preconditions: (i) The issuance of a patent to another WTO member state for the product that is subject of mailbox application. (ii) The securing of marketing approval for the product in the country where the mailbox application is filed.

New Pharmaceutical Pricing Policy (2002)

In 2000, with further economic liberalization, the Foreign Direct Investment (FDI) in the pharmaceutical sector was brought in the automatic route and the limit was raised up to 100%. Following this, a new pharmaceutical pricing policy was introduced in 2002. The turnover limit for purposes of price control was raised from INR 4 crores to INR 25 crores and the parameters of market share were relaxed further. All drugs whose unit price did not exceed INR 2.0 were excluded from the ambit of price control. Drugs developed through indigenous R&D, new delivery systems, etc., were also exempted.

Modelled on WHO's Essential Medicine List (EML), the Ministry of Health launched the list of medicines in the National List of Essential Medicines (NLEM) in 1996, with the revised list notified as NLEM, 2003. In November 2004, a task force under the chairmanship of the Principal Advisor, Planning Commission, Pronab Sen, considered the issue of price control, options other than price control, and other issues and made recommendations for making life-saving drugs affordable based on NLEM, 2003, the latest list at the time. The committee submitted its recommendations in September 2005. The Ministry of Health notified the revised NLEM in 2015 (see Supplementary Table 2). The various drug policies adopted from time to time have tried to cope with the

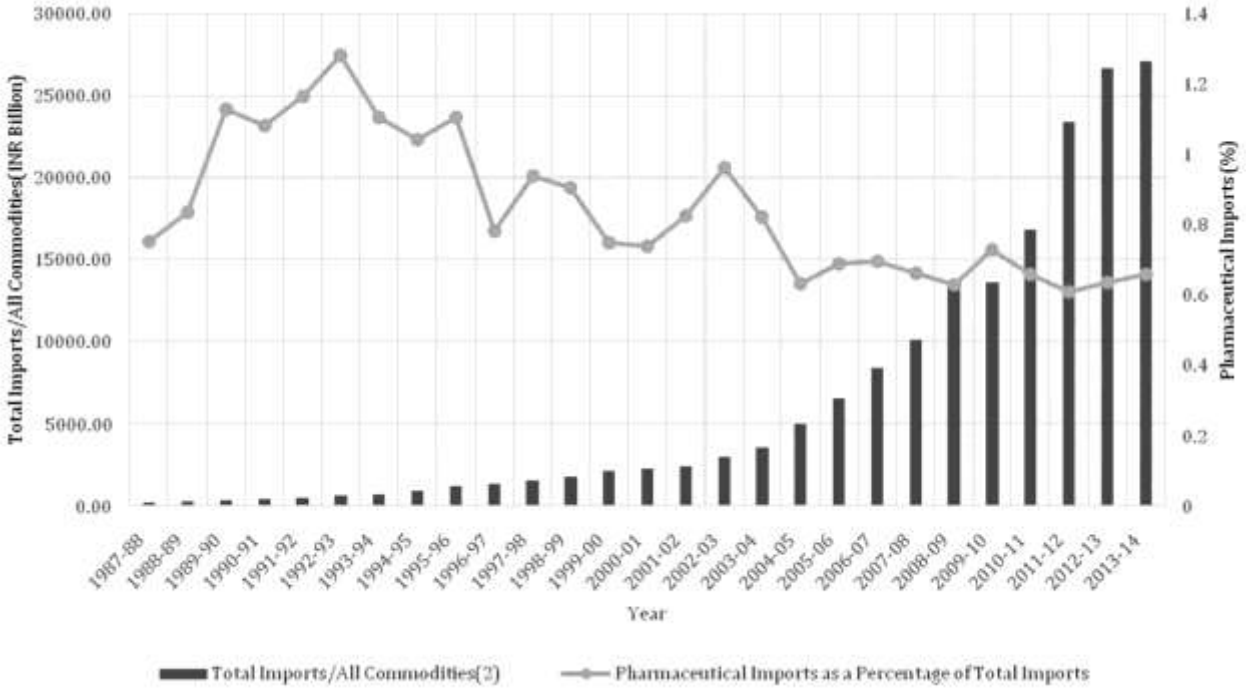

Figure 1. Pharmaceutical imports as a percentage of total imports (INR billion) 1987–2013.

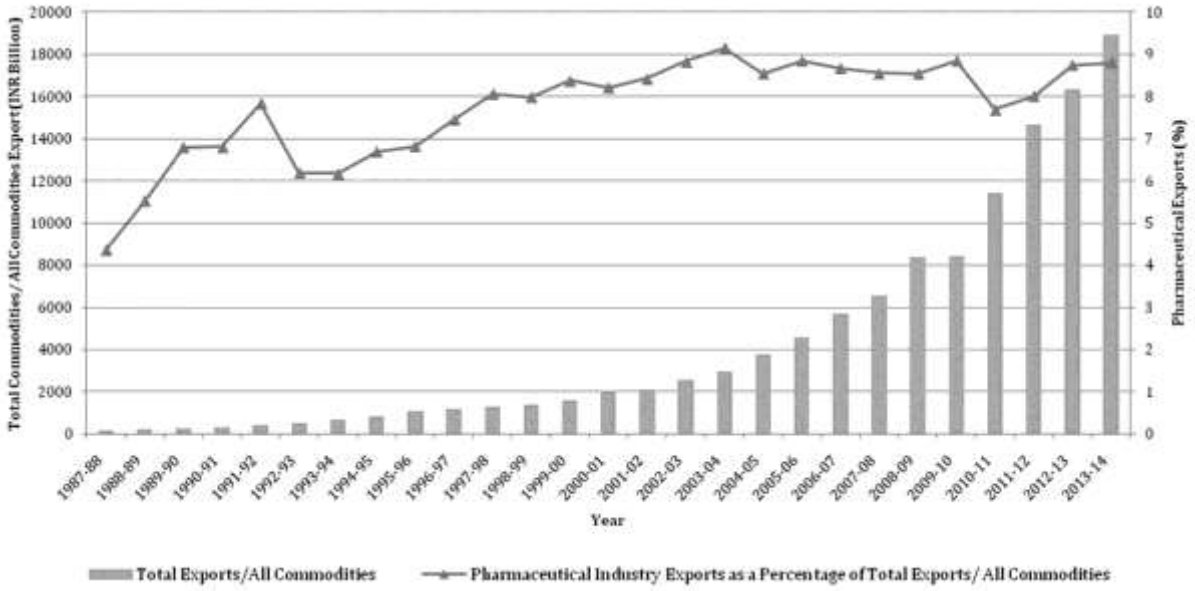

Figure 2. Pharmaceutical exports as a percentage of total exports (INR billion) 1987–2013.

challenge of striking a balance between, at times contrasting requirements of enabling industry to grow, while ensuring affordable medicines. This balancing of diverse and conflicting interests is challenging, as is the reconciling of short-term interests with long term goals and concerns.

The Government is therefore seized with the goal of enabling the growth of the industry with attendant socio-economic benefits along with balancing the declared objective of providing better health care, including making essential medicines available at reasonable prices to all[28].

The National Pharmaceuticals Pricing Policy, 2012 (NPPP-2012)[29] which replaced the Drug Policy of 1994 was introduced to meet the challenges brought about by the competitive international pharmaceutical industry in a

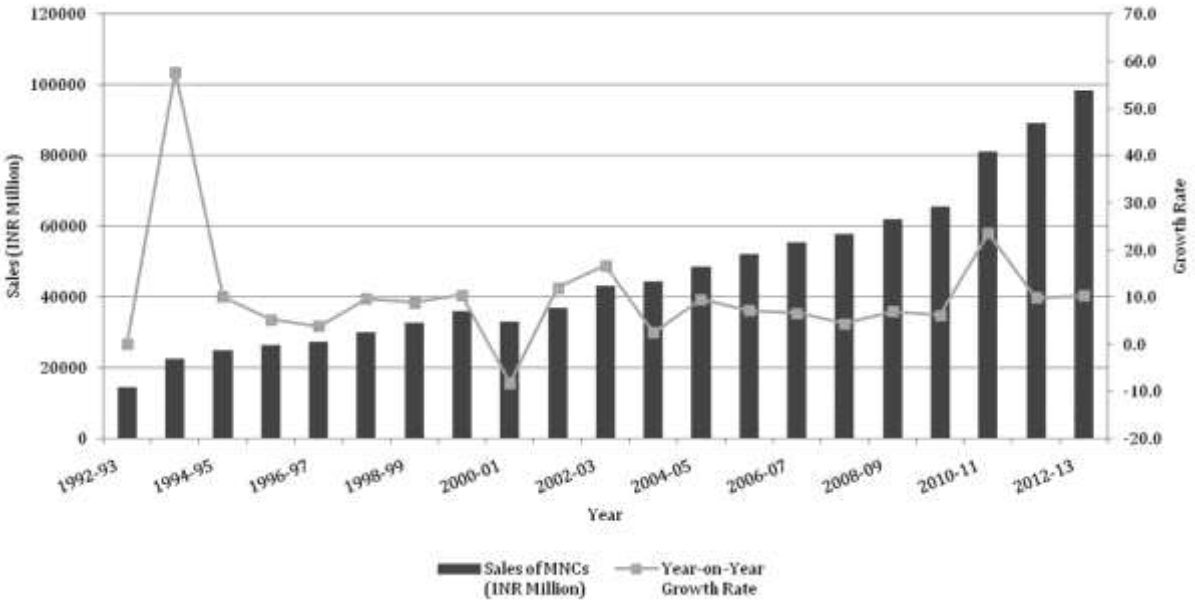

Figure 3. Sales of MNCs in India (INR million) 1992–2013.

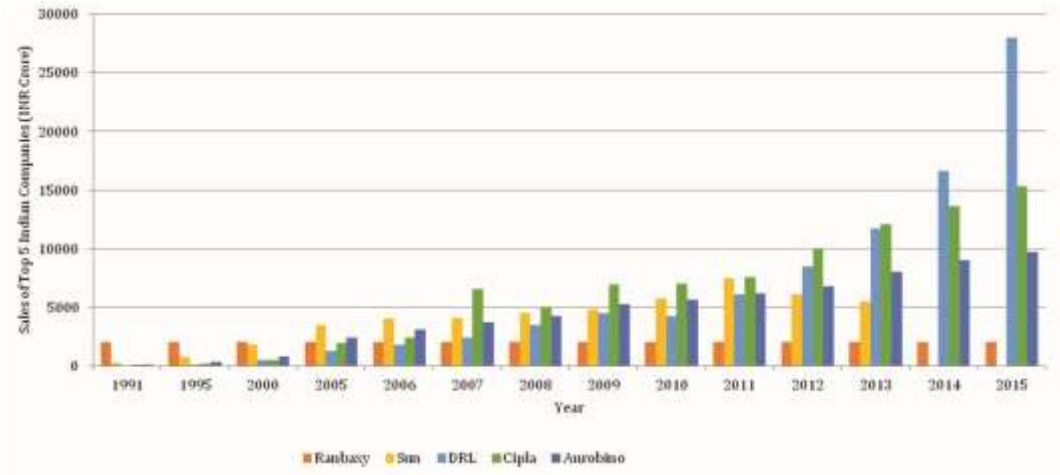

Figure 4. Net sales of top 5 Indian companies (INR crore) (1991–2015).

globalized economic environment, along with meeting the country's requirements for safe and quality medicines at reasonable prices.

Impact of TRIPS (Post 2005)

The implementation of the TRIPS mandate was met with differing views. Indian scepticism was due to an ideological conflict that shifting to a product patent regime would lead to a monopoly, thereby, causing a price surge and decreased access to medicines. Theoretically, patent granting pushes for higher innovation by increasing the competition sphere and creating a demand for greater technological capacity. However, the theory collapses when technological progress does not occur in the same capacity across developed and developing countries, leading to high costs and stagnant technological knowledge, leaving these nations short-changed. India faced this threat as well. Foreign firms saw the TRIPS mandate as an opportunity to revisit the pre-1970 monopolistic era. Given the spectrum of policy tools and checks in place, the domestic pharmaceutical players were better equipped to deal with the impact of TRIPS. We analyse the performance of the pharmaceutical sector using the following measures: (i) Pharmaceutical Trade; (ii) Research and development; (iii) Patents.

Pharmaceutical trade. One of the primary objectives of the Indian industrial policy was to reduce import dependence. Figure 1 highlights how India has progressed in

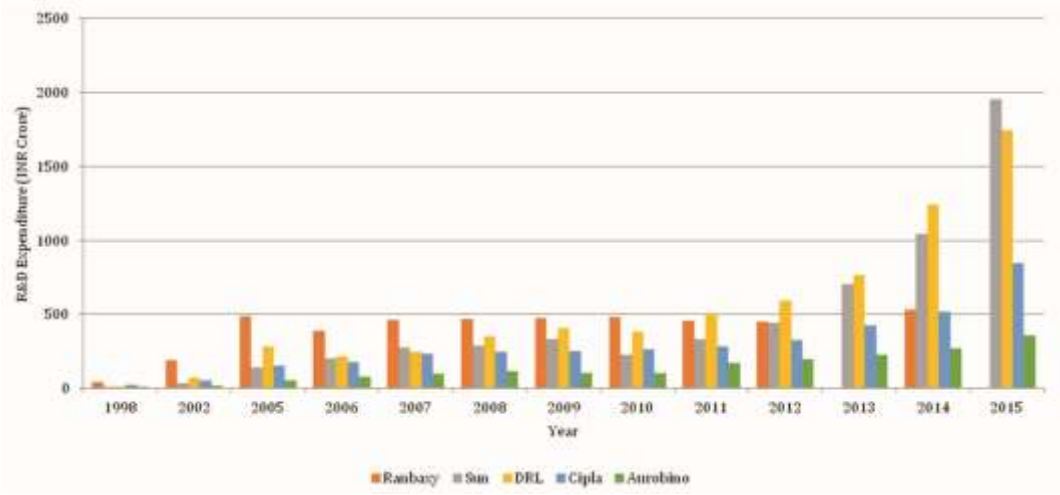

Figure 5. R&D expenditure by Indian firms (INR crore) (1998–2015).

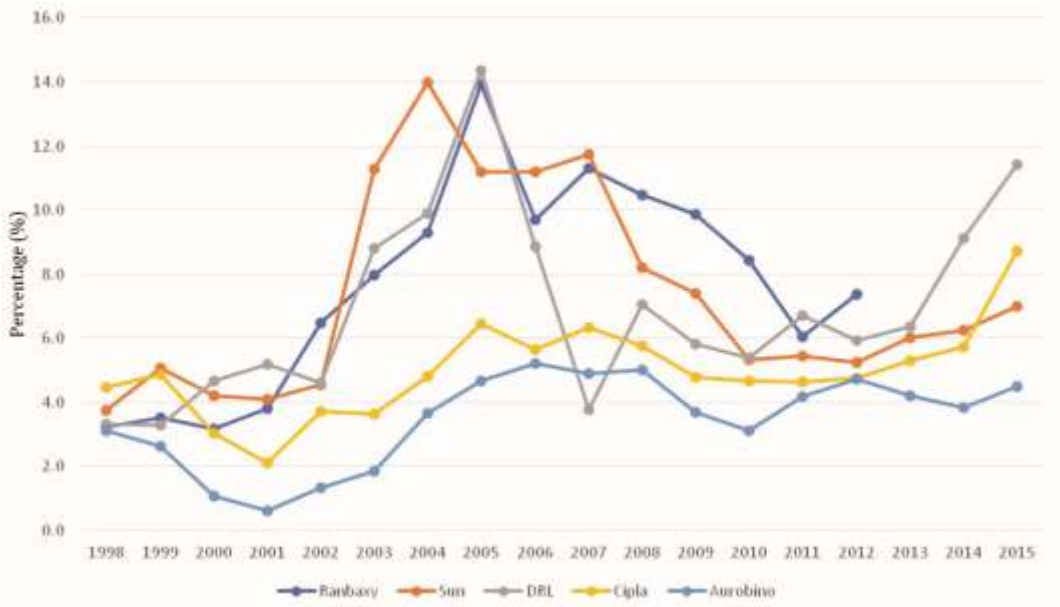

Figure 6. R&D as a percentage of sales in Indian firms.

terms of import substitution. India's pharmaceutical imports remained high during the early nineties and then starkly dipped post 2004 (see Supplementary Table 3). This is attributed to the fact that during the early nineties domestic firms were reverse-engineering drugs and invested close to nil in R&D. Post the TRIPS mandate and patent amendments of 1999, domestic firms, taking an inward approach, started investing in R&D for delivering new products.

Figure 2 highlights pharmaceutical trends in terms of exports, including bulk drugs and formulations. Evidently, pharmaceutical exports have progressively risen over the years. The TRIPS mandate phase shows an upward trend, accounting for nearly 10% of all commodity exports from the country (see Supplementary Table 4).

The trade from eight MNCs was also analysed (note 7)[30].

Though MNC sales have increased steadily, the growth rates show fluctuations in the years corresponding to introduction of various policy measures (Figure 3; see Supplementary Table 5). MNCs also faced the problem of dry drug pipelines, which could be a probable explanation for dip in growth rates. As of 2012–13, formulations worth nearly INR 17 billion were sold by nearly 50 MNCs[31]. This accounts for nearly 2.3% of the INR 700 billion Indian drug market.

This analysis proves that the decision of delayed implementation of the TRIPS agreement prepared domestic firms to technologically evolve themselves to compete with foreign players. Realizing the importance of investing in

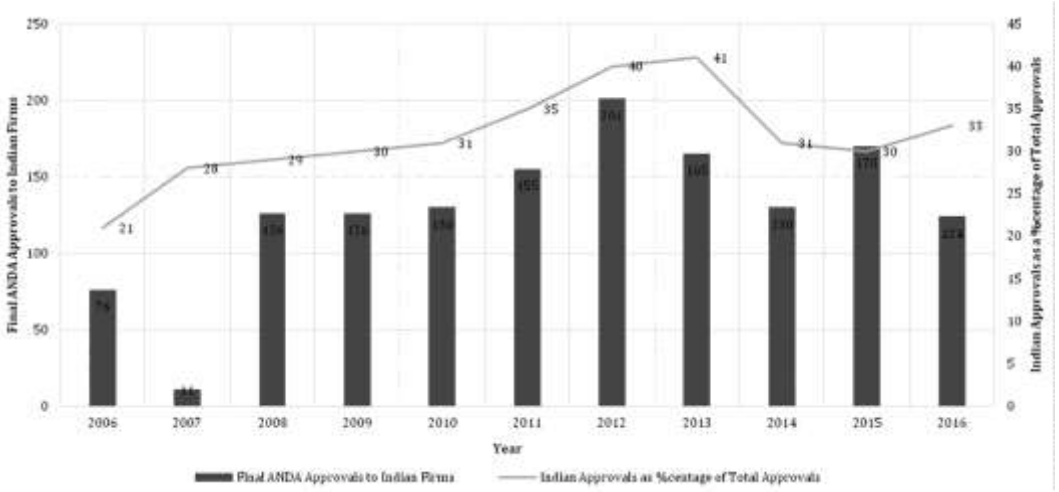

Figure 7. ANDA approvals from India (2006–2016).

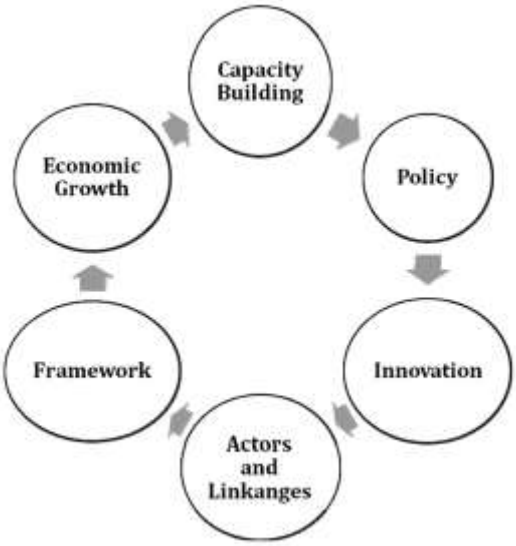

Figure 8. Ecosystem of economic growth.

R&D, Indian firms moved from being generic manufactures to developing patentable products.

Research and development. The worry of the impact of TRIPS caused the domestic firms to expand their scope beyond generic manufacturing. Entering into the space of new molecular entity development (NMEs) required higher R&D investments. TRIPS promoted innovation among the domestic players, and most of them quickly identified the need to expand existing technology and align with the international R&D landscape. Five domestic companies identified with highest market capitalization values, are Sun Pharmaceutical Industries, Dr Reddy's Laboratories (DRL), Cipla, Aurobindo Pharma and Ranbaxy Laboratories (note 8).

As evident, post-2005, the sales of domestic players recorded an upward trend (Figure 4), strengthening their R&D investments[32] (Figure 5; see Supplementary Table 6).

Figure 6 shows the trend of R&D expenditure of the domestic firms as a percentage of their net sales indicating that, post-TRIPS the domestic firms expanded their technological capacity to capture higher market shares (see Supplementary Tables 7 and 8).

Patents. Patents ensure and safeguard viable economic prospects – the most crucial driving factor for any pharmaceutical company. Given this, generic companies are willing to enter into foreign markets, which are governed by tough regulatory processes and stringent patent laws. The 'Drug Price Competition and Patent Restoration Act' (called the Hatch-Waxman Act) was implemented in 1984, allowing Indian generic companies to enter the US markets. There are two types of patent applications that can be filed in the US: Abbreviated New Drug Applications (ANDAs) and Drug Master Files (DMFs). Generic drug applications are termed 'abbreviated' as they are only required to demonstrate the bio-equivalence of the product and not include pre-clinical and clinical data to establish safety and efficacy.

Filing an ANDA requires the company to certify that its product is not infringing any patent rights or that the patent of the product has become invalid[33]. Once the generic application gets the patent nod, the company gets a market exclusivity for 180 days, during which, a competing company cannot enter the market. While DMF, is a confidential information which is filed by a firm with the USFDA, the DMF application is also indicative of the applying firm's intentions to have marketing rights of the product developed. Figure 7 shows the trend in ANDAs approved for Indian firms in the US. A rise in the number

of patents filed by the Indian firms proves that an economic growth is underway in the sector (Figure 8; see Supplementary Table 9).

The National Intellectual Property Rights Policy

The National Intellectual Property Rights Policy ((NIPR) was launched in 2016 laying the framework for promoting an end-to-end ecosystem for intellectual property generation; from creativity and innovation to commercialization and enforcement. The NIPR policy[35] laid down seven objectives: (i) To create public awareness about the benefits of intellectual property among all sections of society; (ii) To stimulate the creation and growth of intellectual property by undertaking relevant measures; (iii) To have strong and effective laws with regard to IP rights, consistent with international obligations; (iv) To modernize and strengthen IP administration; (v) To catalyse commercialization of IP rights; (vi) To strengthen the enforcement and adjudicatory mechanisms for combating IP violations and to promote awareness and respect for IP rights; (vii) Capacity development by strengthening and expanding human resources, institutions for training, research and skill building in IP.

Objective 2 of the NIPR aims for *Generation of IPRs* through various methods, including strengthening public R&D. The sub-objective 2.10 looks at delivering this objective by:

'Encouraging R&D including open source based research such as the Open Source Drug Discovery (OSDD) by CSIR for new inventions for prevention, diagnosis and treatment of diseases, especially those that are life threatening and those that have high incidence in India.'

Conclusion

We have tried to capture in detail the factors responsible for the growth of the Indian pharmaceutical sector, concluding that the most fundamental aspect of economic growth is capacity building. The levels of investment are two-tiered. The private sector is the main actor, driving innovation while the public sector augments growth with sound policy decisions. The whole process creates a continuous ecosystem around which economic growth occurs. Sound policy initiatives drive industrial proliferation, evident in the case of India's pharma industry. The impact of an established policy has an incubation period and the scrutiny of this period under the lens of economic growth and public outreach, would be an indicator of the efficiency of the policy drafted and implemented. India drafted her policies, particularly the pharmaceutical policy, with an inward-looking approach, facilitating attainment of self-sustenance and development.

Notes

1. 1 crore = 10 million
2. The Indian Pharmaceutical sector henceforth would be referred to as Indian pharma.
3. 'It is obvious, indeed, that the master of India, must, under modern conditions, be the greatest power in the Asiatic continent, and therefore, it may be added, in the world. The central position of India, its magnificent resources, its teeming multitude of men, its great trading harbors, its reserve of military strength, supplying an army always in a high state of efficiency and capable of being hurled at a moment's notice upon any given point either of Asia and Africa – all these are assets of precious value. On the west, India must exercise a predominant influence over the destinies of Persia and Afghanistan; on the north, it can veto any rival in Tibet; on the north-east and east, it can exert great pressure upon China, and it is one of the guardians of the autonomous existence of Siam. On the high seas, it commands the routes to Australia and the China Sea.'
4. A bill is the draft of a legislative proposal, which, when passed by both houses of Parliament and assented to by the President, becomes an Act of Parliament.
5. RRL is the former name of the Indian Institute of Chemical Technology (IICT).
6. The Licence Raj was an elaborate system of licences, regulations accompanied by red tape that were required to set up and run businesses in India between 1947 and 1990.
7. Abbott India, AstraZeneca Pharma India, Glaxosmithkline Pharmaceuticals, Merck, Novartis India, Pfizer, Sanofi India, Wyeth
8. As of 2015, Ranbaxy Laboratories was wholly bought by Sun Pharmaceutical Industries.

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