

Analysis of Indian Pharmaceutical Industry and Trade Competitiveness: Using Revealed Comparative Advantage (RCA)

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ABSTRACT

Introduction: This paper examines the growth of the Indian pharmaceutical sector, the changing dynamics and the export competitiveness of therapeutic segments. Further, this study compared the export competitiveness of the therapeutic segments with that of the leading exporting countries. Trade-Related Aspects of Intellectual Property Rights (TRIPS) is considered an emerging point in India's pharmaceutical sector's history. Having skills in making off-patent drugs at low cost contributes to India becoming a pharmacy of the world. With the growing importance of the pharmaceutical industry in the economy and trade, it is essential to investigate India's trade competitiveness with other countries. **Materials and Methods:** The study used Revealed Comparative Advantage (RCA) to analyse the international competitiveness of therapeutic segments with top exporting countries and to find the comparative advantages and disadvantages of therapeutic segments from 2000 to 2022. The assessment of the pharmaceutical sector is based on secondary data collected from the World Integrated Trade Solution (WITS). This classification is based on ITC chapter (30) for pharmaceutical products, heading (3004) given by the Directorate General of Commercial Intelligence and Statistics (DGCIIS). This study used HS 1988/92 and selected India as the reporting country from 2000 to 2022. **Results:** The results indicate that India became more competitive post-TRIPS and patents significantly influenced exports. Further, comparative analyses with top exporting countries revealed that Indian therapeutic segments are more trade-competitive, have a stronger position than the USA and are closer to Germany. The study also found that the Indian pharmaceutical industry has a favourable trade balance and its therapeutic segments are more competitive than the overall pharmaceutical products. The analysis of RCA suggests that India's advantage lies in therapeutic segments. Exports of Indian pharmaceuticals are positively correlated with TRIPS compliance. **Conclusion:** The study concludes that the overall CAGR of the pharmaceutical and therapeutic segments are growing at a healthy rate. However, de-segregating the timeframe showed that, from 2014 to 2022, the CAGR was not the same as the early period and lower than the overall CAGR. Moreover, on the global comparison of therapeutic segments, the study suggests that robust policies and export measures must be taken to compete with countries like Belgium, Switzerland, Ireland and Denmark. Active Pharmaceutical Drugs (APIs) need to be imported (the majority from China) to make the formulation drugs in India, leading to a high dependency on imports of APIs. Therefore, the study suggested that the government should also focus on producing active pharmaceutical drugs domestically, which can reduce the price of drugs in India.

Keywords: Export competitiveness, Patents, Pharmaceutical industry, Revealed Comparative Advantage.

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INTRODUCTION

The Indian pharmaceutical sector emerged from a non-existing position to a pharmaceutical hub. This achievement of the pharmaceutical industry has its history and has gone through

many phases since its inception. The pharmaceutical sector in India is expected to reach a market size of around US\$ 65 billion by 2024 and US\$ 130 billion by 2030.¹ India is the 12th largest exporter of medical goods in the world. Indian drugs are exported to more than 200 countries in the world, with the US being the key market. Generic drugs account for 20% of the global export in terms of volume, making the country the largest provider of generic medicines globally. Transformed over the years as a vibrant sector, presently, Indian pharma ranks 3rd in pharmaceutical production by volume and 14th largest in terms



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of value. Pharmaceutical exports stood at INR 2,08,231 crores for the financial year 2023.¹ The Indian pharma sector traded formulation drugs, bulk drugs and generic drugs. Therapeutic segments are formulation drug segments that are used to prevent, diagnose, treat, or relieve symptoms of a disease or abnormal condition.² The pharmaceutical industry has contributed significantly more to the worldwide market than was anticipated in recent years. 10% of the global COVID-19 pharmaceutical market was supplied by the Indian pharmaceutical sector, which provided affordable COVID-19 drugs to over 100 countries.³ Multinational Companies (MNCs) controlled most of the Indian pharmaceutical market at the time of independence. They import finished drugs from foreign countries and sell them in India without establishing manufacturing units in India during the TRIPS period.⁴ During the early 1970s, the government amended the Indian Patent Act to facilitate process patenting in three areas, including drugs and pharmaceutical products. The scenario of the Indian pharmaceutical industry has changed over the enforcement of the TRIPS agreement and has significantly impacted the evolution of the Indian pharmaceutical industry's structure. Reintroducing the product patent makes it possible for domestic producers to use reverse engineering to create reasonably priced generic medications. The focus of exports has shifted from intermediates and bulk drugs to formulation drugs. Indian firms have become more technically sophisticated and skilled in reverse engineering, exporting more formulations and developing new drug production processes post-TRIPS.^{5,6}

Trade competitiveness is important for the economy since it improves capabilities, resource utilisation, knowledge transfers and currency exchange. Furthermore, a nation's competitiveness enables the measurement of its strengths and weaknesses.⁷ When a nation produces certain commodities and services with greater productivity and product differentiation than other nations in each trading area, it is considered a trade competitive.⁸ A country's export competitiveness is determined by its market development, possession ability and profit-making ability in the international markets where its products are traded.⁹ Pharma products are exportable, and nations can compete on several fronts, including technology, cost and product quality.^{10,11} The standard method for measuring comparative advantages is calculating the RCA index based on trade flow.¹² The underlying assumption is that trade flow can reveal comparative advantages. Let (k) be a product or group of products and let (i) and (j) be two countries. Regarding (k), a higher RCA Index for (i) than for (j) means that (i) has a smaller comparative disadvantage or a larger comparative advantage over (j) for that particular product.¹³

India's pharmaceutical sector is among the fastest-growing in the world and the country's strong export and trade surpluses have placed it in the top ten countries for foreign investment.¹⁴

The Indian pharmaceutical industry is the leading exporter at the international level post-TRIPS. As shown in Figure 1, India's export of pharmaceuticals has been more significant than its imports since 2005. As the Indian pharmaceutical industry significantly affects global competitiveness, India is facing the dual pressure of internal and external competition. The changing dynamics of the export competitiveness of pharmaceuticals have become a challenging issue for India. This study explores changing trends and investigates the therapeutic segments' export competitiveness. This is associated with the policymakers for expanding the pharmaceutical industry and improving the overall national economy.

The Indian pharmaceutical industry has a long history of being self-sufficient in manufacturing medicines and is a significant exporter of bulk drugs and active pharmaceutical ingredients.

In India, pharmaceutical product patents were not recognised before TRIPS, which facilitated the industry's growth through the production of generic versions of off-patent medications. The industry's success was largely due to the presence of product patents, which enabled Indian companies to manufacture and export medicines at a lower cost compared to developed countries. The Indian pharmaceutical industry experienced an increase in exports post-TRIPS, as shown in Figure 1. The study used the RCA Index to analyse the export competitiveness of therapeutic segments with respect to top exporting countries.

The study aims to identify the following specific research questions because of the impact of TRIPS and the growing importance of the pharmaceutical industry in the economy and trade.

How has the growth of exports and imports in India's pharmaceutical industry changed since the implementation of the TRIPS Agreement?

How has the export competitiveness of India's therapeutic segments and overall pharmaceutical products evolved in the post-TRIPS period and how does this competitiveness compare with that of the leading pharmaceutical exporting countries?

The remainder of the article is as follows. Section II presents the literature review, which traces the pharmaceutical sector's trajectory in India and the theoretical background of trade competitiveness and tries to flaunt the trade position of the Indian pharma sector in the past. This section also talks about the objectives of the study. Section III explores the research methodology and data sources used in this study. This section discusses therapeutic segments of formulation drugs and includes the revealed comparative advantage index invented by Bela Balassa. Furthermore, section IV elaborates on the results and discussion of the study. The last section of the study is devoted to the conclusion, which emphasises India's export competitiveness in the therapeutic domains post-product patent regimes.

Literature Review

The World Trade Organisation (WTO) handles trade regulations among member countries. Member countries must follow the 18 special agreements attached to the WTO agreement.¹⁵ The most significant relevance to the health sector is the agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). TRIPS Agreement, binding on all WTO members, must grant such protection within ten years, by 1 January 1995. TRIPS aims to establish strong minimum standards for intellectual property rights.¹⁶ India brought back product patents for chemicals, food and medicines to fulfil its TRIPS responsibilities on March 22, 2005, and repealed its process patent statute.^{17,18} TRIPS are a turning point in the Indian pharmaceutical industry's history. The return of product patents and the increase of the patent period from 7 to 20 years were two significant adjustments made to the TRIPS agreement when it was enacted in India. The impact of TRIPS transformed the Indian pharmaceutical sector completely as the pharmacy of the world. Therefore, domestic firms can produce generic drugs at affordable prices.^{17,6} Before TRIPS, India allowed only process patents, not product patents, enabling companies to legally reverse-engineer patented drugs and produce them using alternative methods. After 2005, with full TRIPS implementation, India had to adopt product patents, restricting the production of new patented drugs. However, this led Indian firms to specialize in generic drugs for the export market, particularly targeting drugs whose patents had expired in high-demand markets like the U.S. and EU. Companies like Cipla, Sun Pharma and Dr. Reddy's pivoted towards becoming global leaders in generics, exporting to numerous countries (Chaudhuri, 2005).

Additionally, TRIPS compliance enhanced India's attractiveness as a partner for contract manufacturing and research outsourcing, where adherence to IP standards reassured multinational corporations of India's reliability. This growth in contract manufacturing, alongside the development of Contract Research Organizations (CROs), positioned India as a preferred hub for pharmaceutical services, benefiting both export volume and industry capability. Indian pharmaceutical companies subsequently increased their investments in R and D, fostering innovation in novel drug development and expanding the export portfolio beyond generics to include high-value biopharmaceuticals and biosimilars. Regulatory alignment with international standards, such as those set by the U.S. FDA and European EMA, further facilitated access to regulated markets and bolstered India's reputation as a trusted pharmaceutical exporter (Chadha, 2009). The TRIPS regime has driven India's pharmaceutical sector towards greater innovation, quality assurance and strategic global partnerships, collectively underpinning the sector's robust export growth and establishing India as a global leader in generic and biosimilar pharmaceuticals. Indian pharmaceutical firms such as Cipla, Sun Pharma and

Lupin have entered into licensing agreements with multinational pharmaceutical companies to produce and export patented medicines. These agreements allow Indian firms to manufacture patented drugs for export to certain markets, usually where the partner holds the marketing rights or where patent protection does not apply. Compulsory licensing provisions under the TRIPS framework allow Indian firms to produce patented drugs for export in situations that address public health needs in developing countries. India has used this approach sparingly but effectively to facilitate access to affordable medicines. In 2012, Natco Pharma received India's first compulsory license to produce a generic version of Bayer's patented cancer drug, Nexavar for the domestic market. While the TRIPS-mandated product patent regime prevents Indian firms from producing and exporting other companies' patented drugs without permission, it has pushed them towards innovative pathways, including partnerships, licensing and original drug discovery, to legally engage in the global market for patented medicines. Leading Indian firms engaged in these exports include Biocon, Cipla, Glenmark, Sun Pharma, Dr. Reddy's Laboratories and Natco Pharma (Pradhan, 2011).

Throughout history, trade has been vital to the expansion of any country's economy. Mercantilists in economics hold that increasing exports contributes to the nation's economic growth. Adam Smith and David Ricardo, two classical economists, shared the same opinion. Both economists created the method for evaluating trade competitiveness. The absolute advantage concept was formulated by Adam Smith in 1776, proposing that nations can effectively create by specialising in particular commodities. In 1817, Ricardo used the comparative advantage to expand on the absolute advantage idea.¹⁹ According to the theory, nations can gain from trade even if they have a monopoly on a certain good and the Heckscher-Ohlin theory predicts the prevalence of inter-industry trade specialisation based on relative factor endowments.²⁰ Subsequently, other theories of global trade were developed to describe its trends and level of competitiveness. Balassa developed a hypothesis based on trade competitiveness in 1965. He created the "Revealed Comparative Advantage (RCA)" technique, which aimed to evaluate a product's or sector's export competitiveness with other countries (Balassa, 1965). Balassa's RCA index helps determine whether a nation has a comparative advantage or disadvantage in the particular goods.²¹ The concept of revealed comparative advantage was first introduced by Bela Balassa (1965), who defined it as the ratio of two factors: the percentage of a country's commodity exports in the total percentage of commodity exports from all countries and the percentage of the country's total manufactured goods exports in the total percentage of manufacturing exports from all the countries in the study, or the entire world²² (Balassa, 1986).

Studies have provided an overview of the pharma industry's structure and trade competitiveness in the international market.

The studies divided the growth into phases, including trade competitiveness evaluations using the RCA, pre- and post-TRIPS analysis, export trends of the pharmaceutical industries and growth in drug and pharmaceutical products imports and exports.^{2,5,23,24} The author assessed trade competitiveness and structural changes in the Indian pharmaceutical sector before and after the implementation of product patents.⁵ The analysis demonstrates the positive impact of product patents on ownership, trade, market structure, disclosed comparative advantage, research and development and mergers and acquisitions. Studies on trade analysis, mainly by Balassa, have revealed comparative advantage indices for trade flows in manufacturing, high-tech and R and D-intensive industries. Analysis of pharmaceutical trade flows is often considered as an aspect of a specific concern pursued in connection with sector-specific products and trade policies.²⁵

The study investigated pharmaceutical trade flows and the relationship between China's pharmaceutical manufacturing industry's innovation and intellectual property rights.²⁶ The comparative advantage index was used to evaluate China's pharmaceutical industry's level of global competitiveness. The results show that China's pharmaceutical manufacturing sector's ability to compete globally is not enhanced by strict IPR protection. The findings demonstrate that stringent IPR protection does not positively affect China's pharmaceutical manufacturing sector's ability to compete internationally.

To date, in literature, an ample number of studies have been undertaken using the concept of export competitiveness. Most studies used Balassa's RCA index only to signify a country's relative ranking of comparative advantage in different commodities bulk and overall formulation segments.^{5,27-29} However, limited research has been conducted on therapeutic segments, their export competitiveness and comparison with pharmaceutical products. The author analysed comparative trade using a newly revealed comparative index invented by Vollrath in 1991 that combines an extension of the standard RCA index by Balassa 1965.¹³ Many economists have attempted to define Balassa's Revealed Comparative Advantage Index, which calculates a country's relative advantage or disadvantage in a class of goods and services based on the trade flow.^{30,13,21} The present study is in tune with these studies, using the RCA Index to measure export competitiveness in therapeutic segments.

After thoroughly reviewing the available literature, the study examines the export competitiveness of the pharmaceutical industry. The pharmaceutical industry has many different aspects, but there are some studies have been done on therapeutic segments and their trade competitiveness. The study examines therapeutic segments and the overall pharmaceutical sector. The study examines therapeutic segments and the overall pharmaceutical sector. The following are the key objectives of the study:

To assess the growth of exports and imports of the pharmaceutical industry in India post-TRIPS.

To examine the export competitiveness of the therapeutic segments and overall pharmaceutical products post-TRIPS. Further, the study also examines the export competitiveness of the therapeutic segments with the top exporting countries.

MATERIALS AND METHODS

In this study, the export competitiveness of the Indian pharmaceutical industry for therapeutic segments has been measured. The authors highlighted formulations that constitute the fastest-growing export category of pharmaceutical products.^{31,2} Overall, pharmaceutical products include bulk drugs, formulation drugs and other pharmaceuticals. Therapeutic segments are formulation drugs used to improve disease symptoms, prevent, diagnose and treat physical and mental disorders, modify or regulate the body's physiological and psychological state and grow an overall sense of well-being. A formulation drug is defined as "a finished dosage form, for example, capsule, tablet, solution, injectable, ointment, semisolid, etc., that contains an active drug ingredient along with other ingredients." Antibiotic drugs, vitamins, NSAIDs, hormones, anthelmintics, analgesics, gastrointestinal, antidepressants, antifungals, anticancer, antineoplastics, antibacterials drugs and other pharmaceuticals are listed in the therapeutic segments.^{32,7}

The assessment of the pharmaceutical sector is based on secondary data collected from the World Integrated Trade Solution (WITS). The entire pharmaceutical product's export-import data set is expressed in US dollars. This classification is based on ITC chapter (30) for pharmaceutical products, heading (3004) given by the Directorate General of Commercial Intelligence and Statistics (DGCIS). The relevant sub-classifications were used for products falling under the 'others' category in chapter 300490.

The data are presented in terms of quantity and classified using the international harmonised commodity description and coding system, generally called the Harmonised System (HS). This study used HS 1988/92 and selected India as the reporting country from the year 2000 to 2022. The 22 years of data are essential since, during this period, many trade policies and reforms have been enforced and crucial amendments in the Patent Act and TRIPS reforms have been undertaken, which affected the pharmaceutical industry.

Further, the study is divided into two essential phases. The 1st phase covers 2000-01 to 2012-13, encompassing the pre- and post-TRIPS regimes.³³ In the second phase, the COVID-19 period has been considered. During COVID-19, the pharmaceutical sector played a crucial role in minimising the damage caused by the pandemic. Thus, the 2nd phase covers the 2013-14 to 2022 pre- and post-COVID-19.

The Revealed Comparative Advantage (RCA) Index is incorporated into the analysis. In essence, the RCA index is used to gauge export competitiveness and to evaluate the level of global competitiveness. RCA was invented by Balassa in 1965 and has been used in past studies.^{3,10,26,30,34,35} RCA analysis helps us understand the changing dynamics of exports in the pharmaceutical sector. It is calculated by using the RCA index:

$$RCA_{ij} = \left(\frac{X_{ij}}{\sum X_i} \right) / \left(\frac{X_{wj}}{\sum X_w} \right)$$

Where X_{ij} is the country's (India) exports of product j (therapeutic drugs), X_{wj} is the world's export of product j , $\sum X_i$ is the country's total exports (all products) and $\sum X_w$ is the world's total exports (all products).

RCA Index measures the international competitiveness of products or a group of products. Values for the RCA range from zero to infinite. On the other hand, it is assumed that a country is a competitive producer and exporter of a given product when its Revealed Comparative Advantage ($RCA > 1$) for j is greater than that of another country's manufacturing and exporting the same good. A nation's export strength for a given product (j) increases with its value ($RCA > 1$) for the product (j). The study highlights the graphs and Figures to assess trends in the export and import of India's pharmaceutical industry, which are useful for comparing the export patterns of therapeutic medications among various nations, predicting the RCA and tracking export activities.

RESULTS

The study's first objective is to assess the performance of the pharmaceutical industry's exports and imports. The study considered export-import of the pharmaceutical sector at the HS code (30) 2-digit level data from 2000 to 2022. The Figure revealed a favourable picture of a growing trade surplus in the pharmaceutical industry.

Figure 1 illustrates India's pharmaceutical trade performance from 2000 to 2022, showing both imports and exports and the resulting trade surplus in the pharmaceutical sector over the years. A significant and consistent upward trend can be observed from 2000 onwards, with exports growing from modest value in 2000 to over 19 USD million by 2022. The pharmaceutical industry's exports are growing exponentially,

whereas the imports of pharmaceuticals are relatively much less than the exports. The growth has been consistent, with imports increasing every year except for a slight dip in 2014, 2020 and 2022. It reflects a mix of global and domestic challenges. In 2014, regulatory and competitive pressures affected trade. In 2020 and 2022, the pandemic disrupted global supply chains and affected India's pharmaceutical trade. With economies worldwide affected by COVID-19, demand for some pharmaceuticals dropped temporarily. Export growth was strong throughout the period, with double-digit percentage increases in most years. Appendix 1 provides a quick overview of the pharmaceutical's export-import and trade surplus. India's pharmaceutical trade has grown significantly in the last 2 decades, with exports increasing faster than imports, creating an extensive and growing trade surplus. This reflects India's emergence as a global pharmaceutical powerhouse and exporter. This tremendous growth in the pharmaceutical sector resulted from the introduction of the TRIPS regime. However, in the post-TRIPS phase (after 2005), the exports rose rapidly, and the trade surplus increased from 1.97 million USD in 2005 to 4.87 million USD in 2010. This may be attributed to the increased efficiency of domestic pharma firms, which makes the pharma sector's price more competitive.³³ From 2010 to 2013, a significant number of patent expirations for drugs in regulated markets like the U.S. and EU. The same results were also identified in the COVID-19 period. Despite the shock of COVID-19, pharmaceutical sector exports rose to a new peak. The trade surplus reached 17.05 million USD in 2022 from 11.08 million USD in 2017. The pandemic highlighted India's strategic importance in global healthcare, with companies ramping up production of COVID-19 medicines like remdesivir, hydroxychloroquine and vaccines. The authors also revealed that the demand for pharmaceutical products increased dramatically during the pandemic.³⁶ However, in the case of the import of pharmaceutical products, India has been resilient in minimising imports and promoting domestic production.

Furthermore, to gain the growth of export of the pharmaceutical sector and therapeutic segment, the study has incorporated the Compound Annual Growth Rate (CAGR) method.^{37,38} The CAGR calculated from the semi-log regression model: $\text{Log} Y = a + bt$, where $\text{growth rate} = (\text{antilog}(b) - 1) * 100$. CAGR is based on the export data of the pharmaceutical sector and the therapeutic segment's

Table 1: CAGR of the therapeutic segments and pharmaceutical sector.

	Year	India's export of Therapeutic (CAGR)	India's export of pharmaceuticals (CAGR)
Pre-TRIPS	2000-05	24.70	21.75
Post-TRIPS	2006-13	22.32	20.68
Pre-COVID-19	2014-18	4.68	4.65
Post-COVID-19	2019-22	5.72	6.65
Overall CAGR	2000-22	15.67	16.73

Source: Authors' estimation based on WITS (World Integrated Trade Solution) Database.

time series. This shows the growth rates of the pharmaceutical and therapeutic sectors during the study period.

Table 1 shows that the therapeutic segments have a CAGR of 24.70% in the Pre-TRIPS phase, more significant than the overall pharmaceutical sector (bulk drugs, formulations and other pharmaceuticals), which was 21.75%. Similarly, in the post-TRIPS phase, the therapeutic segments have a 22.32% CAGR, whereas the 20.68% CAGR of the pharmaceutical sector. However, the growth rate is lower than pre-TRIPS, and the reason may be attributed to the global recession of 2008, which impacted the whole world. In phase two, during the pre-and post-COVID situation, the CAGR is very low compared to the TRIPS phase. In the pre-COVID-19 situation, the CAGR of the therapeutic segments was 4.68% and 4.65% of the pharmaceutical sector.

Moreover, the therapeutic segment growth rate is lower in the post-COVID-19 period (2019-2022). The therapeutic segment growth rate stood at 5.72%, lower than the overall pharma sector, which is 6.65% (Appendix 2). However, globalisation and rising competitiveness may be the reason for the steep decline in the CAGR rates. The decline in pharmaceutical and therapeutic export growth rate is directly influenced by global trade. To assess the competitiveness of the Indian pharmaceutical sector and therapeutic segments, the study incorporated the Revealed Comparative Advantage (RCA). In Figure 2, the pharmaceutical sector at HS-Code 30 and the therapeutic segments at HS-Code 3004 are extracted from the WITS database. These growth rates show that the pharmaceutical sector in India has expanded significantly over the years, except for a brief decline before the onset of COVID-19. Growth rates have moderately recovered in the post-COVID-19 era. Despite the strong growth, there is further potential to increase India's share in global pharmaceutical exports by targeting high-potential products and boosting domestic manufacturing.

Figure 2 highlights the export competitiveness of the overall Indian pharmaceutical products and therapeutic segments as well. Further, the analysis reflects how the overall pharmaceutical products and therapeutic segments are competitive globally. The data reveals that in the pre-TRIPS period (2000-2005) and post-TRIPS phase (2005-2010), therapeutic segments were competitive in the global market, like the overall pharmaceutical products, until 2009, the year of recession. In 2009, both sectors RCA scores were less than 1, indicating low competitiveness in the global market. However, after 2010, the therapeutic segments jumped and became more competitive than the pharmaceutical sector. In phase two, the COVID-19 period, the gap between both sectors is increasing even further. In 2020, the therapeutic segment's RCA score reached 2.66, whereas the pharma sector stood at 1.76. In 2021 and 2022, the RCA index went down for both overall pharmaceuticals and therapeutic segments. The COVID-19 pandemic severely disrupted global supply chains, affecting the production and distribution of medicines.

Lockdowns, labour shortages and transportation delays caused bottlenecks in the movement of raw materials and finished products, making it challenging for manufacturers to maintain a steady flow of exports and imports. Thus, impacting the regular flow of medicine exports. Moreover, countries prioritized local production to reduce dependence on imports, further impacting trade.

During the peak of the COVID-19 pandemic, there was a surge in demand for essential medicines, Personal Protective Equipment (PPE) and vaccines. Countries worldwide increased imports of pharmaceutical products to address health emergencies and stockpile essential medicines. However, as vaccination rates improved and the global demand for pandemic-related pharmaceuticals declined, the extraordinary level of exports was no longer sustainable, leading to a natural fall. The COVID-19 pandemic exposed vulnerabilities in global supply chains, especially for raw materials critical to pharmaceutical manufacturing. Lockdowns, port closures and labour shortages led to significant delays and cost increases, impacting both exports and imports. The industry faced challenges in sourcing Active Pharmaceutical Ingredients (APIs), many of which are produced in China and India, which contributed to price volatility and supply shortages even after the pandemic's peak. Many countries adopted more protectionist policies during and after the pandemic to prioritise domestic pharmaceutical production and reduce reliance on imports. For example, several nations introduced incentives to encourage local production of critical medicines, while others restricted exports of essential drugs. These policy shifts reduced cross-border trade in pharmaceuticals, impacting exports from major producers like India and China. This reveals that during the period of COVID-19, India has exported more therapeutic drugs to the world.

Export of Indian Pharmaceutical and Therapeutic Segment Products to High Income, Developing and Lower Developing Countries.

The study used the WTO classification of countries to analyse the pattern and direction of trade in the pharmaceutical and therapeutic segments. This will give insights into how India trades with other countries according to their economic level. The analyses in Figure 3 are revealed in two phases. The first covers the period from 2000 to 2010, and the second from 2011 to 2022.

Figure 3 shows the export of the therapeutic segments and the overall Indian pharmaceutical sector in relation to the different economic levels of countries. The time frame of 2000 to 2010 reflects that pharmaceutical products and therapeutic drugs were exported mainly to high-income countries. This shows that India has created its market in countries with high per capita income due to its low-price generic drugs. Similarly, India has also exported a significant portion of pharmaceutical and therapeutic products to developing groups of countries. Combining developing and

high-income groups share a large portion of exports. However, India has not exported to low-developed countries. See Appendix 3 and 4 for the detailed values of overall Indian pharmaceuticals and therapeutic segments exported to Developing, High-income and less-developing countries from 2000 to 2022.

From 2011 to 2022, the value of exports is significantly higher than in the earlier period. This indicates that India has achieved tremendous growth in the export of pharmaceutical and therapeutic drugs. Further, the market in high-income and developing countries has increased. Both pharmaceutical and therapeutic segment exports have risen to their new peak in these

markets. Moreover, the market is also expanded in low-developed countries.

Figure 4 highlights that the above countries account for a significant portion of global exports. Appendix 5 reflects the details of the top fifteen exporting countries. Germany contributed the highest in 2022, with a total percentage share of 14.80. India stands in the thirteenth rank with a 2.30% share in the global market. Belgium, Switzerland and the USA shared 11.90, 11.20 and 10.50% respectively. Ireland contributed 8.60% to the overall pharmaceutical export market. China has a 2.60% share in the supply of drugs. These countries, with Belgium and Germany

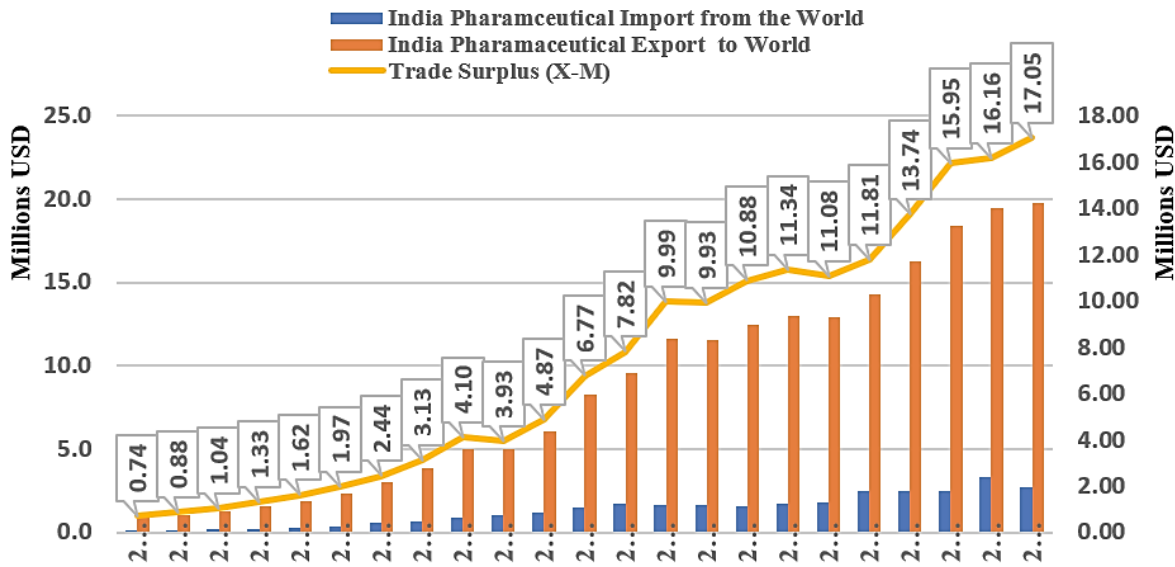


Figure 1: Indian pharmaceutical export-import (HS CODE-30). Source: World Integrated Trade Solution (WITS), 2023. Note: The values are on current prices.

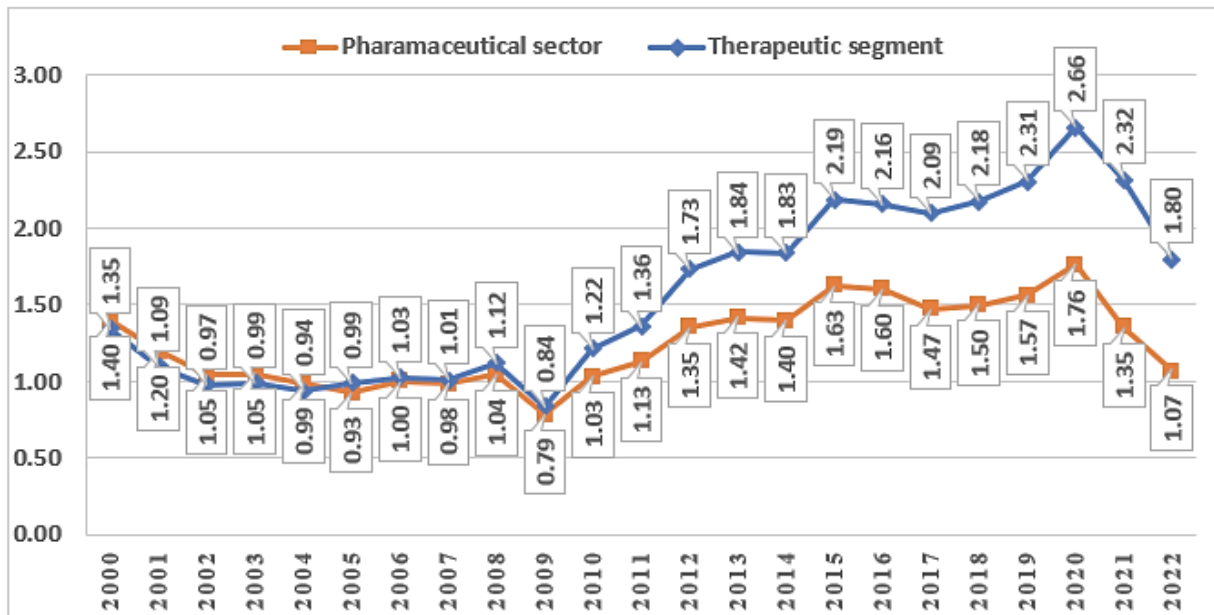


Figure 2: RCA of overall Indian pharmaceutical products and therapeutic segments, 2000 to 2022. Source: Authors' estimation based on WITS (World Integrated Trade Solution) Database.

at the top of the list, are major participants in the international export market. The information emphasises how crucial these nations are to global trade and how much they have contributed to the world economy.

RCA analysis is a widely accepted method for elucidating a nation's export competitiveness for a specific commodity.³ The results found India's position and changing dynamics in the pharmaceutical sector. The above RCA analysis reveals the trade competitiveness of the top exporting pharmaceutical countries in the world. Figure 5 above compares Indian therapeutic segments with the top 13 exporting countries from 2000 to 2022. According to the results, Ireland, Belgium, Denmark and Switzerland have the highest revealed comparative advantage. These countries' RCA trend lines show higher competitiveness than other countries. The analyses show Belgium, Ireland, Denmark and

Switzerland being the most competitive than other countries. At the same time, the remaining countries are below these in the Figure. Notably, India has maintained its comparative edge in the therapeutic sectors, and its RCA index hardly falls below unity. Overall, India's position in the therapeutic segments is higher than that of other countries like the USA, China, Netherlands, France, Italy and the U.K.

In the pre-and post-TRIPS phases, India's position and that of other top exporting countries revealed a different picture. From 2000-01 to 2005-06, India's competitiveness in the therapeutic segments was low compared to other exporters. In the post-TRIPS phase, competitiveness follows a constant path till 2009. Afterwards, the RCA showed a steady increase in the trend line of competitiveness. The analysis reveals that after introducing the patent regime TRIPS, India took advantage

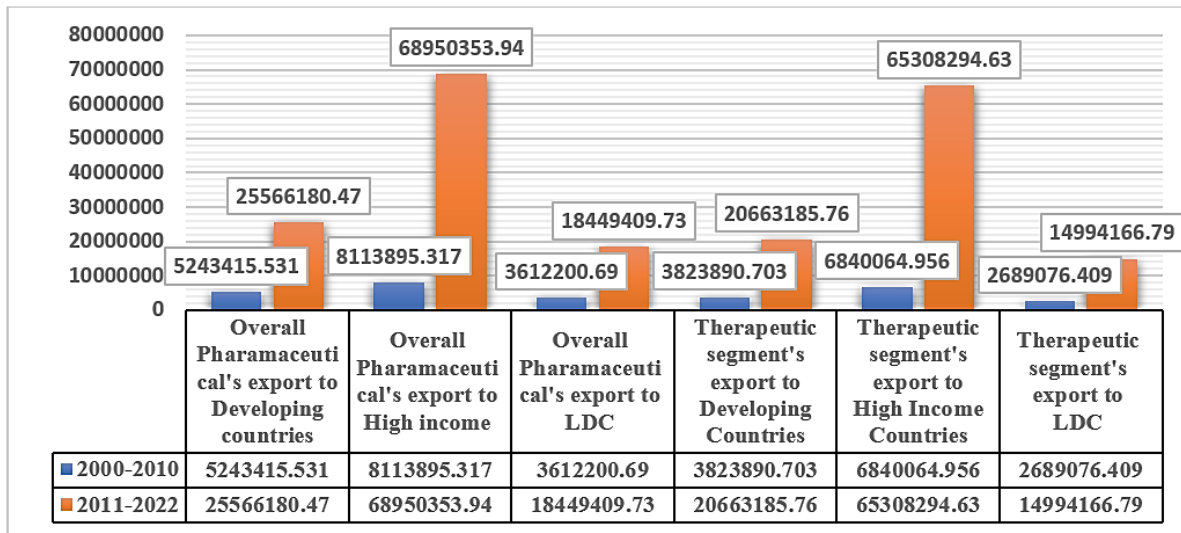


Figure 3: Overall Indian Pharmaceuticals and Therapeutic Segments Export to Developing, High income and LDC's Countries, 2000-2010 and 2011-2022 (In USD thousands). Sources: World Integrated Trade Solution (WITS), 2023.

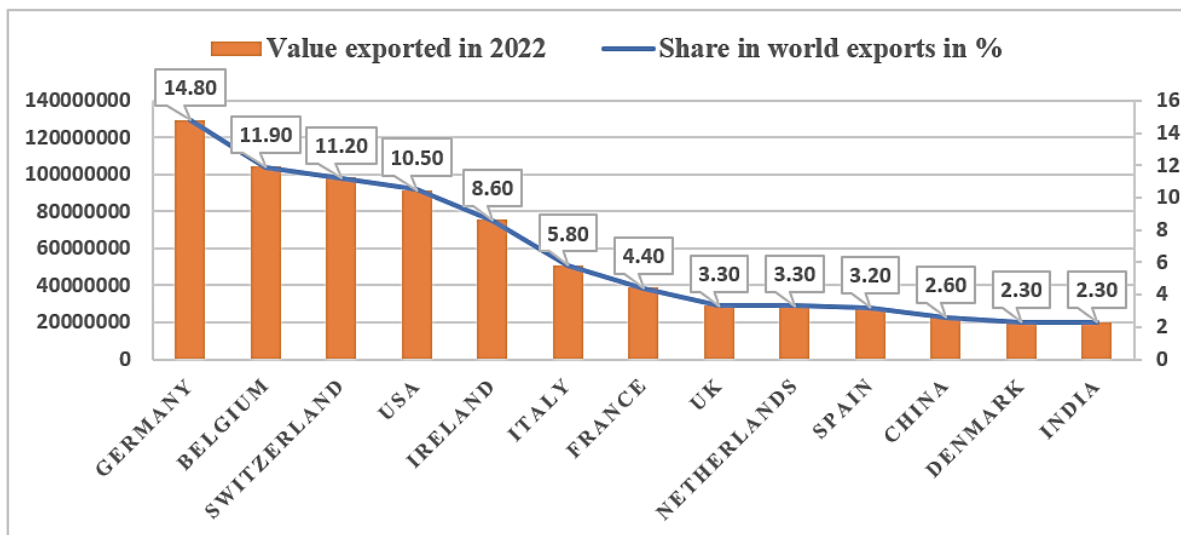


Figure 4: Top exporting countries in the pharmaceutical sector, 2022 (In thousand US \$). Sources: ITC calculations based on UN COMTRADE and ITC statistics, 2022.

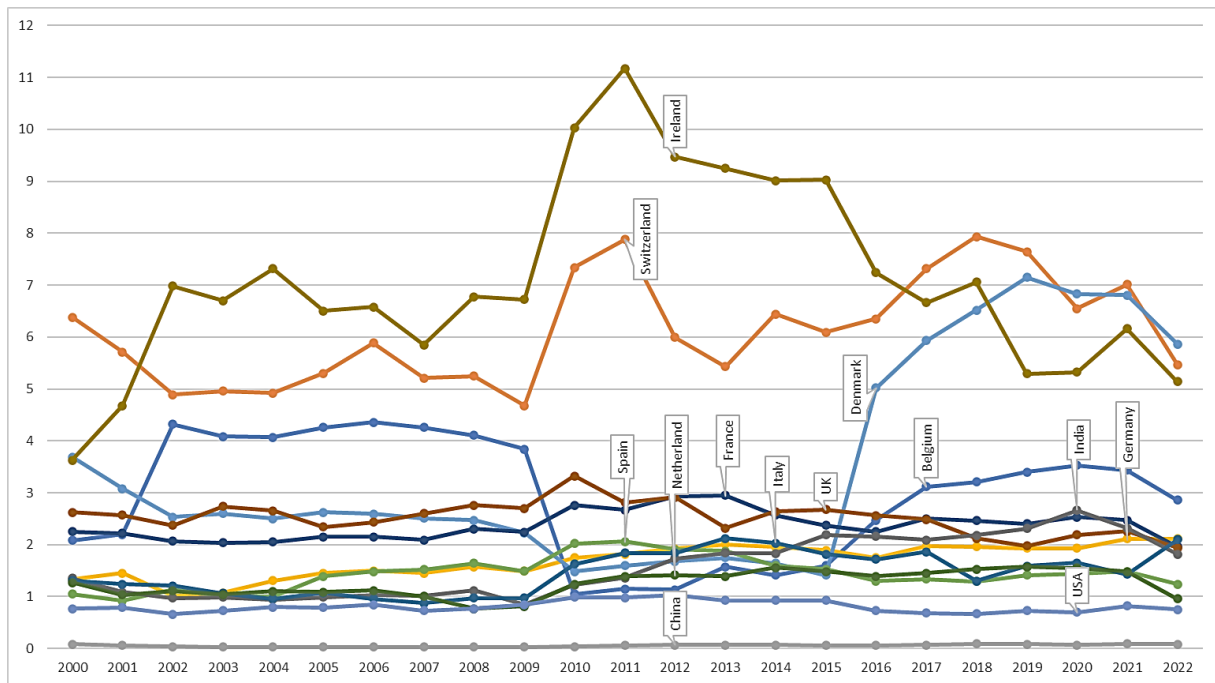


Figure 5: Comparison of Indian therapeutic segments with top exporting countries, 2000 to 2022. Source: World Integrated Trade Solution (WITS), 2023.

and increased its exports to other countries. During the patent regime taken under study, India's position showed the country becoming more competitive and secured a good position among the developed nations. However, India is still far behind highly competitive countries. For say, Ireland, Belgium, Denmark and Switzerland were the most competitive during and even before the patent regime. These developed nations have the highest RCA values, reflecting their dominance in the therapeutic segment.

However, during the COVID-19 pandemic, these countries experienced a significant decline in RCA value. Phase two includes the COVID-19 pandemic period. The graph reveals the impact of COVID-19 on the pharmaceutical sector's trade, especially the therapeutic segments. From 2014-15 to 2019-20, the RCA of India shows a different picture compared to other top exporters of the world. In 2020, India showed a spike in trade competitiveness in the therapeutic segments, whereas other countries like Ireland and Switzerland showed a dip in their exports. Germany, USA and Belgium show minor changes in competitiveness in this period. However, as the pandemic controlled and the lockdown eased in many countries, the trade competitiveness of Ireland and Switzerland improved in 2021 and then dipped again in 2022.

Similarly, India also showed a declining trend after 2020. Even in a declining competitive phase, India holds a strong position against countries such as the USA, China, Netherlands and Spain. Similarly, India has a very high RCA score compared to countries like Germany, the U.K. and Italy (Appendix 6). It highlighted the strong competitiveness in India's therapeutic segments.

DISCUSSION

The study explored that the pharmaceutical industry's exports are growing exponentially in the nation, whereas the imports of pharmaceuticals are relatively much less than the exports. The pharmaceutical trade has grown significantly in the last two decades, with exports increasing faster than imports, creating an extensive and growing trade surplus. However, in the post-TRIPS phase (after 2005), the exports rose rapidly and the trade surplus increased from 1.97 million USD in 2005 to 4.87 million USD in 2010.

However, after 2010, the therapeutic segments jumped and became more competitive than the pharmaceutical sector. In phase two, the COVID-19 period, the gap between both sectors is increasing even further. The analysis of RCA suggests that India's advantage lies in therapeutic segments. In 2020, the therapeutic segment's RCA score reached 2.66, whereas the pharma sector stood at 1.76. This reveals that during the period of COVID-19, India has exported more therapeutic drugs to the world. To examine the global performance of the Indian therapeutic segments, the competitiveness of the therapeutic sector compared with that of top exporting countries. India ranked thirteenth position as an exporter among the leading pharmaceutical exporting countries.

Regarding the value of pharmaceutical exports, Germany is the top country in the world, whereas Switzerland secured the second position, followed by Belgium, the USA and Ireland. Among them, China ranked eleventh and is a strong competitor for India. However, to reveal true competitiveness, the RCA of these countries is included in the analysis. The whole analysis reflects that after the implementation of the patent regime TRIPS,

India took advantage and raised its exports to other countries. In 2020, India showed a spike in trade competitiveness in the therapeutic segments, whereas other countries like Ireland and Switzerland showed a dip in their exports. Germany, the USA, and Belgium show minor changes in competitiveness during this period. However, as the pandemic controlled and the lockdown eased in many countries, the trade competitiveness of Ireland and Switzerland improved in 2021 and then dipped again in 2022. Similarly, an abating trend has also been explored after 2020 in India. Even in a declining competitive phase, the nation holds a strong position against countries such as the USA, China, Netherlands and Spain. Similarly, India has a very high RCA score compared to countries like Germany, the U.K. and Italy. The study also explored the high dependency on the import of Active Pharmaceutical Drugs (APIs), which are required to produce formulation drugs in India, and China is the leading exporter of India.

CONCLUSION

This paper provides and discusses some measures of the pattern of global pharmaceutical trade flows. Eventually, a nation will import certain products while exporting variants of the same product. Because of this intra-industry trading, comparative advantages should be shown in both exports and imports using an RCA index. The analysis of RCA suggests that India's advantage lies in therapeutic segments. Exports of Indian pharmaceuticals are positively correlated with TRIPS compliance. Today, India is renowned as a 'world pharmacy', which is the outcome of various measures, efforts and policy implementation. From 2000 to 2022, the world has gone through many important events, such as the introduction to TRIPS, the global recession and, more recently, the COVID-19 pandemic. Throughout the period, the pharmaceutical sector has undergone many changes in its structure and R and D. In the pandemic, the pharma sector has the potential to minimise its impact. However, some bottlenecks need to be addressed. The therapeutic segments are the heart of the overall pharmaceutical sector. The study found that India holds a strong position in both sectors and is expected to grow further. However, the study explores a gap that needs to be addressed by policymakers.

Furthermore, the study revealed that the overall CAGR of the pharmaceutical and therapeutic segments are growing at a healthy rate. However, de-segregating the timeframe showed that, from 2014 to 2022, the CAGR was not the same as the early period and lower than the overall CAGR. The study recommends that the pharmaceutical sector's investment be channelled to boost production and quality. Further, the study also mentions that India takes advantage of the expanding market size in LDCs. This will help domestic producers speed up production and export more volume to emerging markets. Moreover, on the global comparison of therapeutic segments, the study suggests that

robust policies and export measures must be taken to compete with countries like Belgium, Switzerland, Ireland and Denmark. This can be achieved by a favourable domestic production environment and by creating new exporting zones to increase exports.

India's pharmaceutical industry is becoming increasingly important worldwide, as seen by its growing exports and trade competitiveness. The current study undertook the same and it analyses the trade competitiveness in comparison to top exporters of the pharma sector. The study found that India is comparatively better than the USA in trade competition and has strong competition with Germany during COVID-19. However, the nation is in a weaker position than Denmark, Belgium, Switzerland and Ireland's trade competitiveness. Nevertheless, India has shown a growing trade competitiveness in the therapeutic categories. The paper indicates that the Indian pharmaceutical industry has a favourable trade balance and its therapeutic segments are more competitive than the overall sector. It also reveals that India is exporting more than it imports. The study shows that India's therapeutic segments are proliferating and can potentially export to the global market. The study also focuses on the need to strengthen policies like Production-Linked Incentive Schemes (PLIs), which support domestic drug producers and enhance the production of the pharmaceutical industry in India. The study concludes that the government is also required to promote research and development activities in the Indian pharmaceutical sector, leading to an increase in output and capital for research and innovation in therapeutic areas.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

TRIPS: Trade-Related Aspects of Intellectual Property Rights; **RCA:** Revealed Comparative Advantage; **WITS:** World Integrated Trade Solution; **DGCIS:** Directorate General of Commercial Intelligence and Statistics; **CAGR:** Compound Annual Growth

Rate; LDCs: Less Developed Countries; HS-Code: Harmonized System Code.

SUMMARY

This paper examines the growth of the Indian pharmaceutical sector, the changing dynamics and the export competitiveness of therapeutic segments. Further, this study compared the export competitiveness of the therapeutic segments with that of the leading exporting countries. The study explored that, presently, Indian pharma ranks 3rd in pharmaceutical production by volume and 14th most significant in value. Pharmaceutical exports stood at INR 2,08,231 crores for the financial year 2023. Multinational Companies (MNCs) controlled most of the Indian pharmaceutical market at the time of independence. Multinational corporations import finished drugs from foreign countries and sell them in India without establishing manufacturing units in India during the TRIPS period. The focus of exports has shifted from intermediates and bulk drugs to formulation drugs. Indian firms have become more technically sophisticated and skilled in reverse engineering, exporting more formulations and developing new drug production processes post-TRIPS. Trade competitiveness is important for the economy since it improves capabilities, resource utilisation, knowledge transfer and currency exchange.

Furthermore, a nation's competitiveness enables the measurement of its strengths and weaknesses. The standard method for measuring comparative advantages is calculating the RCA index based on trade flow. The study used the RCA Index to analyse the export competitiveness of therapeutic segments with respect to top exporting countries. This study used HS 1988/92 and selected India as the reporting country from 2000 to 2022. Exports of Indian pharmaceuticals are positively correlated with TRIPS compliance.

Further, the study mentions that India takes advantage of the expanding market size in LDCs. This will help domestic producers increase production and export more volume to emerging markets. The results show that the Indian pharmaceutical industry has a favourable trade balance and its therapeutic segments are more competitive than the overall sector. Similarly, India's position in the pharma sector also displays an increasing trend in trade surplus and the analysis of RCA suggests that India's advantage lies in its therapeutic segments.

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Appendix 1: India Export-Import, Trade Surplus, Export-Import Ratio (In USD Thousands).

Year	India Pharmaceutical Import from the World	India Pharmaceutical Export to World	Export-Import Ratio	Trade Surplus (X-M)
2000	149806.792	885123.733	5.91	735316.94
2001	163802.553	1047143.316	6.39	883340.76
2002	217530.14	1259037.875	5.79	1041507.74
2003	231878.073	1565502.157	6.75	1333624.08
2004	289403.591	1908546.13	6.59	1619142.54
2005	378564.66	2343595.257	6.19	1965030.60
2006	553456.153	2991143.748	5.40	2437687.60
2007	699595.418	3832123.662	5.48	3132528.24
2008	901273.886	5003346.063	5.55	4102072.18
2009	1077327.26	5009556.533	4.65	3932229.27
2010	1221329.191	6093215.944	4.99	4871886.75
2011	1473827.092	8246148.466	5.60	6772321.37
2012	1752555.806	9569575.969	5.46	7817020.16
2013	1663090.644	11656176.03	7.01	9993085.39
2014	1626219.715	11557858.15	7.11	9931638.44
2015	1611918.37	12495537.47	7.75	10883619.10
2016	1692166.772	13027662.72	7.70	11335495.95
2017	1802521.712	12880696.33	7.15	11078174.62
2018	2480870.37	14286763.74	5.76	11805893.37
2019	2519681.975	16258401.64	6.45	13738719.66
2020	2470081.01	18420767.04	7.46	15950686.03
2021	3289061.073	19452223.26	5.91	16163162.19
2022	2735719.926	19788347.65	7.23	17052627.72

Source: World Integrated Trade Solution (WITS), 2023.

Appendix 2: CAGR of Pharmaceutical Export and Therapeutic Segment (In USD Thousands).

	Year	Indian Export of Pharmaceutical	Indian Export of Therapeutic
Pre-TRIPS	2000	885123.733	664050.797
	2001	1047143.316	763777.612
	2002	1259037.875	952563.696
	2003	1565502.157	1182995.489
	2004	1908546.13	1472700.694
	2005	2343595.257	2011306.906
CAGR		21.75	24.70
Post-TRIPS	2006	2991143.748	2452789.525
	2007	3832123.662	3077177.892
	2008	5003346.063	4128397.716
	2009	5009556.533	3969467.112
	2010	6093215.944	5153395.476
	2011	8246148.466	7003487.067
	2012	9569575.969	8404590.698
	2013	11656176.03	10314192.73

CAGR		20.68	22.32
Pre-COVID-19	2014	11557858.15	10302888.76
	2015	12495537.47	11235844.72
	2016	13027662.72	11612096.1
	2017	12880696.33	11530421.05
	2018	14286763.74	12781828.02
CAGR		4.65	4.68
Post-COVID-19	2019	16258401.64	14638991.48
	2020	18420767.04	16635337.66
	2021	19452223.26	17122488.23
	2022	19788347.65	17451463.2
CAGR		6.65	5.72
Overall CAGR	2000-2022	15.67034168	16.73841939

Source: World Integrated Trade Solution (WITS), 2023

Appendix 3: Overall Indian Pharmaceuticals and Therapeutic Segments Export to Developing, High Income and LDC's, 2000-2010 and 2011-2022.

	WTO Member Countries	Year		
		2000-2010	2011-2022	Overall
Total trade in USD 1000	ALL	1131809736	3584952781	4716762516
	Developing	226359273.5	781049817.5	1007409091
	High	530546123.5	1627693110	2158239234
	LDCs	53347594.17	283883736.7	337231330.9
Pharmaceuticals export in USD 1000	ALL	27353733.97	152626241.5	179979975.5
	Developing	5243415.531	25566180.47	30809596
	High	8113895.317	68950353.94	77064249.26
	LDCs	3612200.69	18449409.73	22061610.42
Therapeutic export in USD 1000	ALL	21992855.2	136191052.3	158183907.5
	Developing	3823890.703	20663185.76	24487076.46
	High	6840064.956	65308294.63	72148359.58
	LDCs	2689076.409	14994166.79	17683243.2

Source: World Integrated Trade Solution (WITS), 2023.

Appendix 4: Overall Indian Pharmaceuticals and Therapeutic Segments Import to Developing, High Income and LDC's Countries, 2000-2010 and 2011-2022.

	WTO Member Countries	Year		
		2000-2010	2011-2022	Overall
Total Import in USD 1000	ALL	1499908903	5232765723	6732674625
	Developing	401504563.8	1761632244	2163136808
	High	732821362.2	2458440040	3191261402
	LDC	33256713.09	148971926.6	182228639.6
pharmaceuticals import in USD 1000	ALL	5832588.329	24841740.06	30674328.39
	Developing	512502.006	3943354.871	4455856.877
	High	2834955.415	9331341.26	12166296.68
	LDC	66812.224	109438.244	176250.468
Therapeutic import in USD 1000	ALL	3692334.265	13061959.78	16754294.04
	Developing	168611.016	1265277.873	1433888.889
	High	2053791.598	5039908.852	7093700.45
	LDC	16663.346	2497.804	19161.15

Source: World Integrated Trade Solution (WITS), 2023.

**Appendix 5: Top exporting countries in the pharmaceutical sector, 2022.
Product: 30 (Pharmaceutical product)**

Country	Value exported in 2022 (USD thousand)	Share in world exports (In %)
Germany	129185214	14.8
Belgium	104248119	11.9
Switzerland	98363189	11.2
USA	91724504	10.5
Ireland	75569437	8.6
Italy	50932010	5.8
France	38879738	4.4
UK	29106605	3.3
Netherlands	28667465	3.3
Spain	28168572	3.2
China	23044503	2.6
Denmark	19915607	2.3
India	19799945	2.3
Slovenia	15325171	1.8
Austria	13769381	1.6

Source: World Integrated Trade Solution (WITS), 2023.

Appendix 6: RCA of top 13 exporting countries and India, 2000 to 2022.

Year	Belgium	Switzerland	China	Germany	Denmark	Spain	France	UK	India	Ireland	Italy	Netherland	USA
2000	2.08	6.38	0.08	1.33	3.69	1.05	2.25	2.62	1.35	3.63	1.31	1.27	0.77
2001	2.2	5.71	0.06	1.45	3.08	0.92	2.22	2.57	1.09	4.68	1.24	1.03	0.79
2002	4.32	4.89	0.04	1.02	2.53	1.13	2.07	2.37	0.97	6.98	1.21	1.11	0.66
2003	4.08	4.96	0.03	1.07	2.6	1.02	2.04	2.74	0.99	6.7	1.06	1.04	0.73
2004	4.07	4.92	0.03	1.31	2.5	1	2.05	2.65	0.94	7.32	0.96	1.1	0.8
2005	4.26	5.3	0.03	1.45	2.62	1.39	2.15	2.34	0.99	6.5	1.07	1.09	0.79
2006	4.36	5.89	0.03	1.5	2.59	1.48	2.15	2.43	1.03	6.58	0.96	1.12	0.84
2007	4.26	5.21	0.03	1.45	2.51	1.52	2.09	2.6	1.01	5.85	0.87	1	0.73
2008	4.11	5.25	0.03	1.57	2.47	1.64	2.3	2.76	1.12	6.78	0.97	0.77	0.77
2009	3.84	4.68	0.03	1.49	2.23	1.49	2.24	2.7	0.84	6.72	0.97	0.81	0.84
2010	1.05	7.34	0.04	1.75	1.48	2.02	2.76	3.32	1.22	10.03	1.63	1.24	0.99
2011	1.15	7.88	0.06	1.82	1.6	2.06	2.67	2.81	1.36	11.17	1.84	1.39	0.98
2012	1.13	5.99	0.07	1.92	1.68	1.91	2.93	2.91	1.73	9.47	1.84	1.41	1.03
2013	1.57	5.43	0.07	2.01	1.75	1.88	2.95	2.32	1.84	9.25	2.12	1.39	0.93
2014	1.41	6.44	0.07	1.95	1.64	1.6	2.57	2.64	1.83	9.01	2.03	1.56	0.93
2015	1.6	6.09	0.06	1.89	1.41	1.53	2.37	2.68	2.19	9.03	1.82	1.48	0.93
2016	2.47	6.35	0.06	1.75	5.02	1.3	2.25	2.56	2.16	7.24	1.72	1.39	0.73
2017	3.12	7.32	0.07	1.97	5.93	1.34	2.5	2.49	2.09	6.66	1.86	1.45	0.68
2018	3.21	7.93	0.09	1.96	6.52	1.29	2.46	2.12	2.18	7.06	1.3	1.53	0.67
2019	3.4	7.64	0.08	1.93	7.15	1.41	2.4	1.98	2.31	5.29	1.59	1.57	0.73
2020	3.53	6.55	0.07	1.93	6.83	1.44	2.53	2.19	2.66	5.32	1.65	1.55	0.7
2021	3.44	7.01	0.09	2.11	6.81	1.48	2.47	2.26	2.32	6.16	1.43	1.48	0.82
2022	2.86	5.47	0.08	2.11	5.86	1.24	1.96	1.94	1.82	5.14	2.1	0.96	0.75

Source: Author's calculation.