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Article

India's Pharmaceutical Export Competitiveness in the U.S. Market: Evaluating Opportunities Under the China+1 Strategy

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Abstract

Amid shifting global dynamics—driven by rising geopolitical tensions, escalating labor costs in China, and supply chain disruptions from the United States (U.S.)-China trade war and the COVID-19 pandemic—the China+1 strategy has gained momentum as companies seek to diversify manufacturing beyond China. These shifts have opened space for alternative manufacturing locations, with India in a strong position to expand its role as a global pharmaceutical hub. This study evaluates India's pharmaceutical export competitiveness in the U.S. market using three indices: Revealed Comparative Advantage (RCA), Comparative Advantage by Countries (CAC), and Market Comparative Advantage (MCA). Based on data from 2003 to 2023, the analysis shows that India maintains competitiveness in most pharmaceutical categories—particularly under HS Codes 3001, 3003, 3004, 3005, and 3006—while showing weaker performance in 3002 and 3005. Although India holds a stable position in U.S. exports, its overall global competitiveness remains uneven due to low RCA values in several categories. These findings highlight the need for a more targeted, product-specific export strategy to strengthen India's position in global pharmaceutical supply chains amid ongoing realignments in trade and sourcing.

Keywords

China+1 strategy, Comparative advantage, Pharmaceutical industry, Exports, Competitiveness, India, U.S.

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Introduction

The global economic landscape has undergone significant shifts, driven by escalating geopolitical[1] tensions among major nations. In response, many multinational corporations have adopted the "China+1" strategy—an approach aimed at reducing overdependence on China by relocating or expanding parts of their manufacturing operations to other countries, typically within Asia, while maintaining a presence in China (Enderwick, 2011; Rahaman et al., 2021). This approach gained momentum during the United States (U.S.)–China trade war initiated under the first Trump administration (2017–2021), with policies such as tariffs on Chinese goods and the "Make America Great Again" agenda prompting businesses to reassess their reliance on China as a manufacturing hub (Fajgelbaum et al., 2024).

While the diversification trend intensified during the trade war, it predates this period, with companies in Japan and the U.S. planning similar moves since 2008. One key driver of this shift was the rising labor costs in China, with minimum wages in certain regions increasing by over 30% between 2010 and 2016 (Huang et al, 2021). These rising costs have made alternative markets such as India, Vietnam, and Indonesia increasingly attractive to businesses seeking to manage costs during economic downturns (Wolf, 2020). Moreover, supply chain disruptions caused by the COVID-19 pandemic underscored the risks of overreliance on China, compelling companies to explore new growth markets. Strict lockdowns and restrictions imposed by China, a significant industrial hub, caused production and shipment delays. This led to shortages of essential parts, including consumer items, medical supplies, and semiconductors, highlighting the dangers of relying too much on one nation for supply chain and industrial activities (Hancock & Mora, 2023)

India's role as a potential global manufacturing hub has gained increased attention in recent years, particularly through the "Make in India" initiative, which aims to attract investment and strengthen domestic production capabilities. One industry that stands to benefit significantly from the China+1 strategy is pharmaceuticals (Vachani, 2024). As the United States—the world's largest importer of pharmaceutical products—seeks to reduce its dependence on China, India emerges as a strong alternative. With its skilled workforce, supportive policies, robust infrastructure, and adherence to strict regulatory standards, India is increasingly viewed as a preferred destination for businesses looking to diversify manufacturing operations. Moreover, India already holds a significant position in the U.S. pharmaceutical market, accounting for approximately 30% of total sales and 40% of the volume market share (Times of India, 2024). This established presence, combined with proven capabilities in producing cost-effective generics and a well-developed global market network, positions India to attract multinational investments and capitalize on evolving trade policies and supply chain strategies (Government of India, 2023a).

India has made continuous progress in diversifying its pharmaceutical supply chain, particularly for APIs (Active Pharmaceutical Ingredients). While China remains a major supplier, India is boosting domestic production and seeking alternative sources to strengthen local manufacturing of essential drugs and chemicals. These efforts aim to reduce dependency on China and improve supply chain resilience. To support this, the Indian government has implemented a production-linked incentive (PLI) scheme, which has achieved notable success. For example, 32 plants now produce critical APIs, reducing India's dependence on imports, especially from China (Economic Times, 2023).

Additionally, the U.S. is the world's largest pharmaceutical market, accounting for about 44% of global pharmaceutical spending in 2023 (Statista, 2025) making it an important market for India's pharmaceutical industry. Strong competitiveness in the U.S. ensures continued growth, global credibility through Food and Drug Administration (FDA) compliance, and expanded

opportunities in other regulated markets, solidifying India's position as a global pharmaceutical leader.

Given the strategic importance of these developments, and the limited research focused specifically on India's pharmaceutical export competitiveness in the U.S. under the China+1 framework, this study aims to fill that gap through a focused empirical analysis. Despite a growing body of literature on the China+1 strategy and its implications for global supply chains (Basu & Ray, 2022; Hong et al., 2006), research specifically analyzing India's pharmaceutical export competitiveness in the U.S. market remains limited. While previous studies have examined the evolution of India's pharmaceutical industry (Aggarwal, 2006; Pradhan, 2006) and its comparative advantage in global trade (Gupta, 2009), there is a lack of detailed, product-level analysis of India's competitiveness in the U.S. market—particularly in the post-COVID-19 era. This study addresses this gap by conducting a comprehensive evaluation of India's pharmaceutical export performance within the China+1 framework.

Export competitiveness, rooted in the concept of comparative advantage, refers to a nation's ability to sell products effectively in global markets (Gupta, 2009; Ketels, 2010). According to David Ricardo's theory of comparative advantage, countries benefit from specializing in the production and export of goods they can produce at a lower opportunity cost relative to others (Ricardo, 1817). In the case of pharmaceuticals, India's strength in manufacturing high-quality, cost-effective generic drugs positions it to leverage this advantage in international markets—particularly as global supply chains adjust to reduce dependence on China. Using empirical trade metrics such as Revealed Comparative Advantage (RCA), Comparative Advantage by Countries (CAC), and Market Comparative Advantage (MCA), this research evaluates India's competitive position in the U.S. pharmaceutical market. Specifically, the study seeks to: (1) examine India's export performance in the U.S., (2) evaluate the role of government policies (e.g., PLI, FTAs) in enhancing India's pharmaceutical sector, and (3) assess the impact of global supply chain shifts on India's pharmaceutical exports to the U.S.

This study is particularly timely and relevant, given the economic and geopolitical shifts in global trade. As major pharmaceutical consumers, both India and the U.S. stand to benefit from more resilient and diversified supply chains, particularly in light of vulnerabilities exposed by the COVID-19 pandemic. The findings of this research will provide valuable insights for policymakers, industry stakeholders, and researchers, offering data-driven recommendations for enhancing India's role as a global pharmaceutical supplier.

The remainder of this paper is organized as follows: Section 2 provides a detailed overview of India's pharmaceutical industry, highlighting its evolution and key characteristics. Section 3 examines the export performance of India's pharmaceutical sector, focusing on competitiveness and global positioning. Section 4 outlines the methodology and data sources used in the study. Section 5 presents the results, offering an in-depth analysis of the findings. Finally, Section 6 concludes the paper, summarizing the key insights and discussing their implications.

Overview of India's Pharmaceutical Industry

The Indian pharmaceutical industry has a rich historical background shaped significantly by British colonial influence. Its origins can be traced back to the early 19th century with the establishment of a medical training institution in Calcutta in 1835, which introduced allopathic medicine to India (Robert, 2024). Initially reliant on British imports, the industry experienced a pivotal shift in 1901 when Acharya P.C. Ray founded Bengal Chemical and Pharmaceutical Works, the first Indian-owned drug factory (Ghosh, 2020). The late 19th and early 20th centuries

were characterized by advancements in medicine, including Louis Pasteur's discoveries and the establishment of key institutions such as the Haffkine Institute (Hawgood, 2007). However, until 1939, the market remained dominated by British manufacturers, with only a few Indian enterprises emerging.

Post-World War II, the Indian government sought to promote self-sufficiency by enacting the Drugs Act of 1940 and establishing regulatory bodies to oversee industry standards. The Industrial Policy Resolution of 1956 further facilitated growth by enabling both state and private sector participation, which led to the establishment of public enterprises such as Hindustan Antibiotics. This period marked India's transition from colonial dependence to a burgeoning pharmaceutical sector characterized by indigenous innovation and strong government support (Ramachandran & Rangarao, 1972).

Significant growth occurred in the post-independence era, with the sector receiving a major boost through the implementation of the Patent Act in 1970. This legislation allowed for the production of generic versions of patented drugs (Zacharias & Farias, 2002). Prior to the Patent Act, India's pharmaceutical market was dominated by multinational corporations (MNCs), which contributed minimally to domestic bulk drug production (Jha, 2007). The Act's provision for process patents (as opposed to product patents) enabled Indian firms to reverse-engineer production processes and manufacture generic copies of patented medications, thereby reducing drug costs. Even after India switched to product patents in 2005 to comply with the Trade Related Aspects of Intellectual Property Right (TRIPS) agreement, the country retained mechanisms like compulsory licensing and Section 3(d) provisions, which prohibit the "ever greening" of patents (Acharya, 2019). These measures have ensured continued affordability of medicines and fostered India's growth in the generic drug market.

The establishment of Drug Price Control Orders (DPCO) in 1979 further strengthened the industry by regulating the prices of essential drugs and preventing excessive profits. DPCO targeted essential medicines produced by both domestic companies and MNCs. By capping prices, it aimed to protect consumers from unaffordable price hikes (Sindhwani, 2019). To enforce these regulations, the National Pharmaceutical Pricing Authority (NPPA) was established in 1997, playing a key role in monitoring drug prices and ensuring compliance with the DPCO. While the introduction of product patents in 2005 restricted the production of generics for newly patented drugs, the DPCO—implemented under NPPA's oversight—has played a critical role in mitigating potential price increases and maintaining drug affordability. As a result, by the 1980s and 1990s, domestic companies thrived, reducing the market share of MNCs from 75% in 1971 to 35% (Joshi, 2003).

The liberalization policy of 1991 was a turning point for India, propelling economic growth by reducing trade barriers, attracting foreign capital, and introducing key reforms in sectors like electricity and pharmaceuticals. This shift fostered technology transfers and increased Foreign Direct Investment (FDI), which enhanced India's global competitiveness and spurred industrial growth (Kathuria, 2002). Industry-specific bodies like the Pharmaceuticals Export Promotion Council (Pharmexcil), established in 2004 dedicated exclusively to with the aim of improving India's global presence in the pharmaceutical sector, have further played a crucial role in promoting pharmaceutical exports.

However, despite these advancements, India's dependence on imports, especially from China for APIs, remained a significant challenge. The COVID-19 pandemic exposed the vulnerabilities of this reliance, disrupting global supply chains and prompting temporary export bans on essential medicines.

In response to these challenges, India has focused on innovation and Research and Development (R&D), aligning with the China+1 strategy to diversify its supply chains and reduce

dependence on China. A key initiative in this strategy is the PLI scheme, which supports domestic manufacturing of APIs, drug intermediates (DIs), and key starting materials (KSMs). The PLI targets the production of 41 critical pharmaceutical components and aims to achieve self-reliance, thereby strengthening the resilience of India's pharmaceutical sector (PricewaterhouseCoopers, 2020).

Not only in production by volume, but India is also making big strides in innovation. The industry is advancing in biosimilars, gene therapy, and new drug delivery methods like nano-formulations and 3D-printed drugs, building a competitive edge globally (Deloitte, 2024). The Indian government has also developed initiatives like the National Biopharma Mission and BIRAC to make approvals and regulations for the clinical trial sector more simpler and efficient (Shrinivasan et al., 2020) At the same time, drug discovery and R&D in this sector is expanding with funding from the National Research Foundation and collaborations with Council of Scientific & Industrial Research (CSIR), Indian Council of Medical Research (ICMR), and National Institute of Pharmaceutical Education and Research (NIPER) (Press Information Bureau, 2019).

Over the past three decades, these developments have transformed India's pharmaceutical sector to play a critical role in the global market gaining international recognition as the "Pharmacy of the World," (Mohanta et al., 2023).

Revenue wise as well, the Indian pharmaceutical sector has emerged as an important and profitable industry for India, demonstrating a robust growth trajectory (Fig. 1). Beginning at $7.58 billion in 2016, the sector displayed steady increases, reaching $9.21 billion by 2020. This growth was driven by India's competitive edge in generic drug production, increasing global demand for affordable medicines, and its strategic position in global pharmaceutical supply chains (Department of Pharmaceuticals, 2023b). A surge occurred in 2021, with revenue reaching $12.11 billion, largely due to heightened demand during and after the COVID-19 pandemic, as India emerged as a key supplier of vaccines and essential medicines globally (Press Information Bureau, 2023). Although revenue dipped to $11.14 billion in 2022, the sector rebounded to $12.76 billion in 2023. Looking ahead, revenues are projected to reach $13.18 billion in 2024

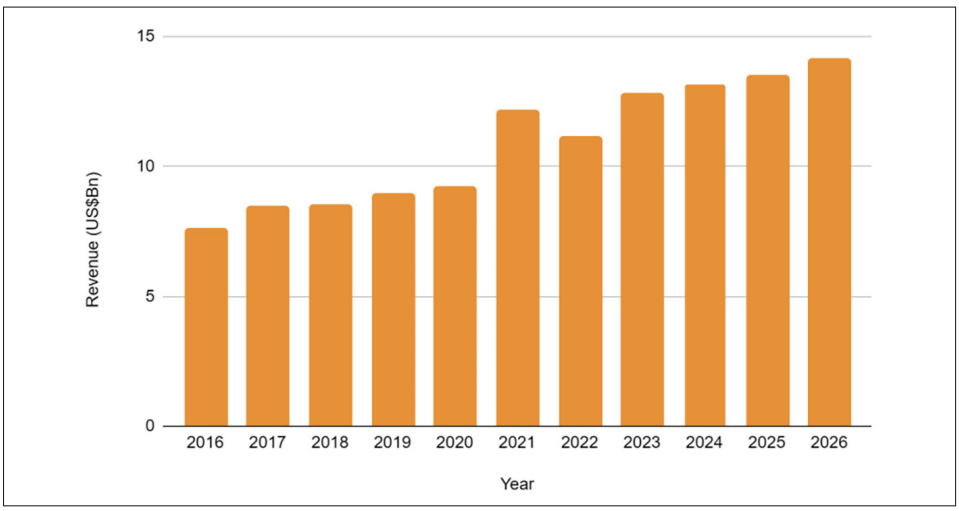

Figure 1. India's pharmaceutical industry revenue generation (US$ Bn)
Source: Statista (2024)

and $14.1 billion by 2026, driven by government initiatives, expanded production capacity, and rising global demand for affordable healthcare solutions (Press Information Bureau, 2023). This trajectory highlights India's pivotal role in global healthcare and its standing as a leading player in the pharmaceutical industry.

The Indian pharmaceutical sector is also one of the major sources of FDI inflows, reflecting its significant global standing and economic importance. Backed by an investor-friendly FDI policy, the sector permits 100% FDI under the automatic route for medical devices and Greenfield projects, while Brownfield projects allow up to 74% FDI through the automatic route, with government approval required for higher levels of investment. The sector contributes about 3.71% of total FDI inflows in the country across various sectors. In the financial year 2022-23 Department of Pharmaceuticals approved 13 FDI proposals, resulting in an FDI inflow of US$2058 million for Brownfield projects, further demonstrating the sector's resilience and attractiveness to global investors. As illustrated in Fig. 2, the steady rise in FDI inflows highlights the sector's pivotal role in driving India's economic growth and establishing its leadership in the global pharmaceutical market (Department of Pharmaceuticals, 2023b).

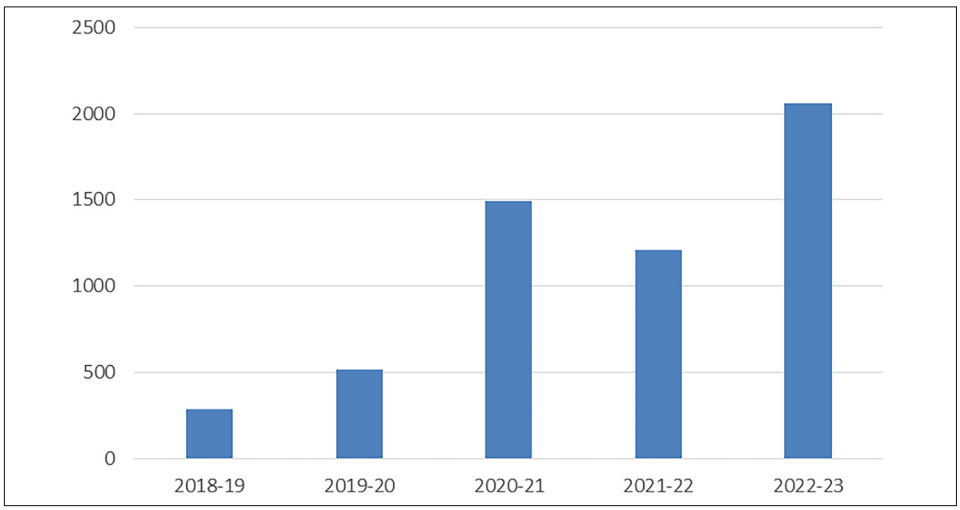

Figure 2. FDI inflows in pharmaceutical sector (US$ Million)
Source: Compiled from data provided by DPIIT

India is the third-largest producer of APIs, contributing 24% to the global market and manufacturing over 500 different APIs. APIs are critical biologically active components in drugs that produce therapeutic effects, accounting for approximately 35% of the pharmaceutical market. This growth has been driven by the increasing demand for cost-effective, high-quality APIs; particularly as global pharmaceutical companies seek alternatives to sourcing from China amid geopolitical tensions.

Since 2000, API manufacturing in Asia, especially in India and China, has surged, with Asia now dominating the global API landscape, accounting for 59% of global manufacturers. The growing desire for supply chain diversification has created a favorable environment for India, which is projected to grow at a compound annual growth rate (CAGR) of 13.7% in the coming years.

India also accounts for 41% of the global distribution of valid Certificates of Suitability

(CEPs)[2], amounting to 3.786 billion units. China follows with a 13% share, while the rest of Asia (ROA) contributes 8%. Europe accounts for 33% of the global distribution, with notable contributions from Italy (9%), Spain (5%), Germany (5%), and France (2%), alongside 12% from the rest of Europe (ROE). This distribution underscores India's predominant role, in the global distribution of CEP's

Renowned for its advanced capabilities in producing cost-effective generic drugs, the Indian pharmaceutical sector exports high-quality, affordable medicines to over 200 countries. Its ability

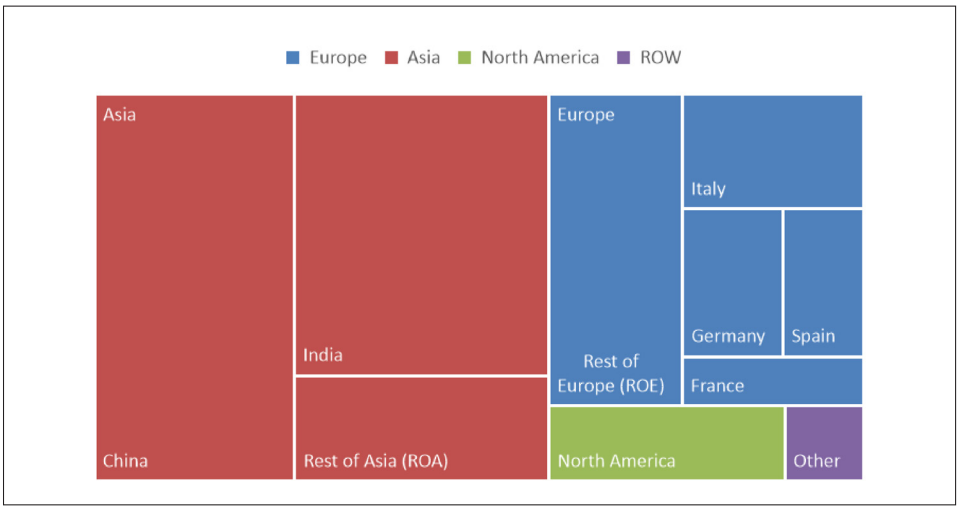

Figure 3. Global distribution of currently valid API (2020)
Source: Pro generika (2020)

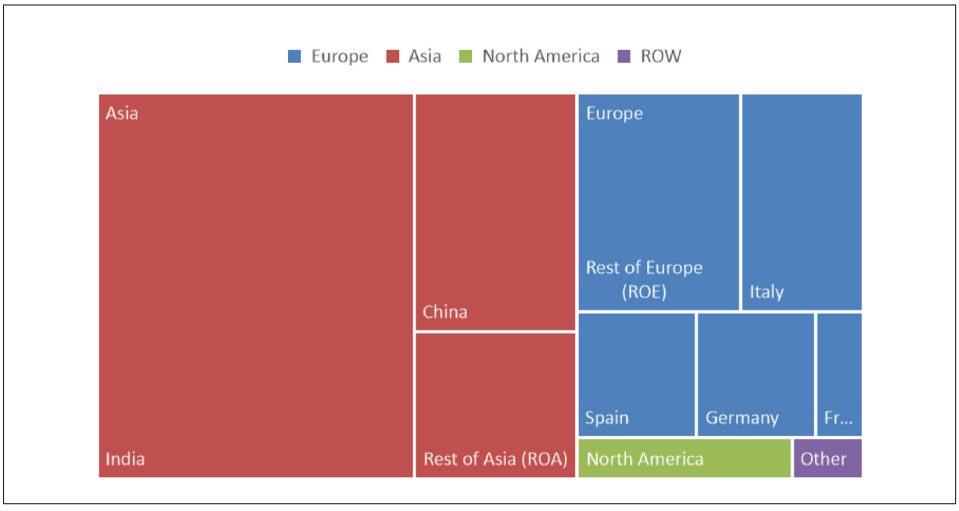

Figure 4. Global distribution of currently valid CEPs (2020)
Source: Pro generika (2020)

to deliver affordable medicines without compromising quality highlights its commitment to accessible healthcare solutions (Basu & Ray, 2022).

The data below highlights India's exceptional position as a global leader in affordable healthcare, with drug prices deviating -73.82% below the global median in 2019. This stands in stark contrast to most developed and high-income countries like the U.S., Germany, and United Arab Emirates, where prices significantly exceed the global median (Times of India, 2019). Even China, often viewed as a major player in pharmaceutical manufacturing, records only a -24.82% deviation, demonstrating that India's pricing remains far more competitive (Times of India, 2019). India's ability to offer such low-cost medicines can be attributed to its robust generic drug industry, efficient production systems, and economies of scale (Sadam, 2024). The Indian Pharmaceutical industry not only ensures domestic affordability but also plays a pivotal role in supplying high-quality, cost-effective medicines globally, particularly to low- and middle-income countries (Shah & Katz, 2024). This trend highlights India's crucial role in addressing global healthcare challenges and promoting equitable access to medicines.

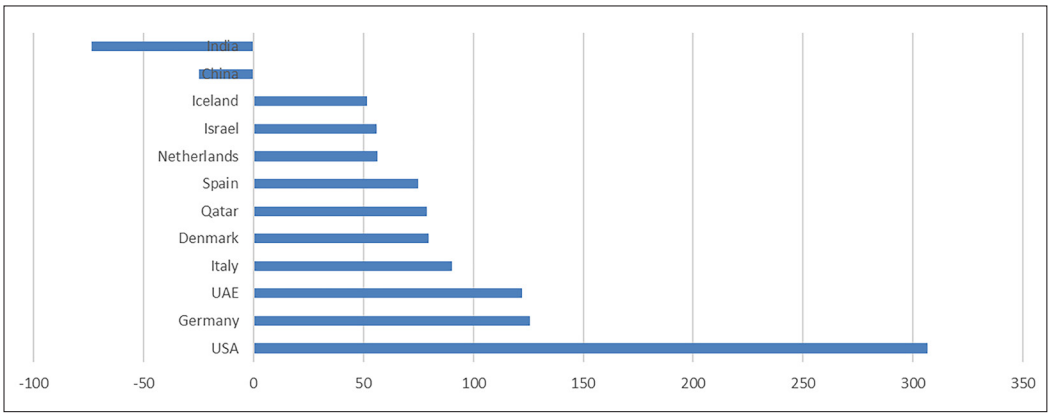

Figure 5. Branded/Generic drugs (% Deviation from Global Median Price, 2019[3])
Source: 2019 Medicine price index

India also has the highest number of United States Food and Drug Administration (USFDA) approved pharmaceutical plants outside the U.S. (Press Information Bureau, 2019). India is home to about 650, or 25% of USFDA approved plants outside the U.S. (Pilla, 2024) and a significant number of World Health Organization (WHO) Good Manufacturing Practices (GMP)-compliant plants as well as plants approved by regulatory authorities of other countries (Pilla, 2024). In the year 2022, Indian companies continued to dominate, securing 355 approvals (48%) of the total 556 approvals, up from 42% (267 approvals) the previous year—a 33% increase from 2021. This solidifies India's leading position in ANDA approvals, well ahead of the U.S., China, and European countries

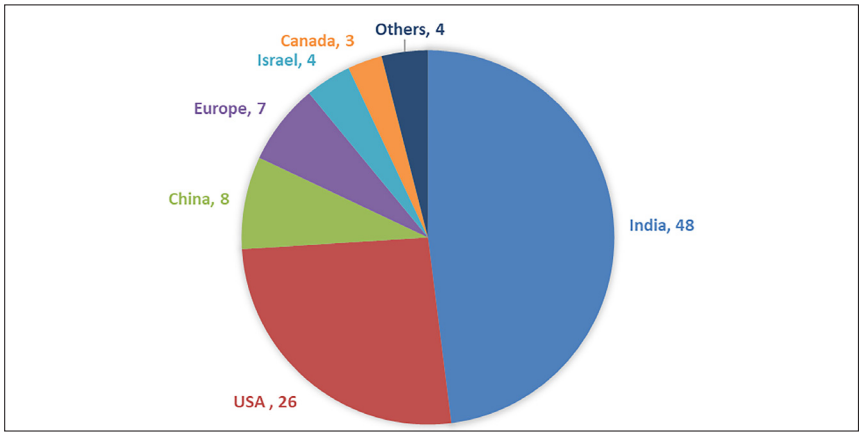

Figure 6. Regional breakdown of US FDA ANDA approvals in 2022 (% Share)
Source: EP New bureau (2023)

India's Export Performance of Pharmaceutical Industry

Examining India's pharma exports to the world from 2003 to 2023, exports have seen significant growth, increasing from $1.57 billion to nearly $21.30 billion, representing an approximately fourteen-fold increase (Fig. 7). This growth trajectory underscores India's expanding role in the global pharmaceutical market. After the 2008 financial crisis, India's pharmaceutical exports began a steady resurgence, with the pace of growth accelerating notably post-2010. The average annual increase in exports was 10.5% post-2010 compared to 7.2% in the preceding years.

Between 2003 and 2004, exports increased by approximately 22%, followed by growth rates of 23% in 2005 and 28% in 2006. A significant surge occurred between 2007 and 2008 with a 30% increase, after which the growth stabilized to annual increases ranging from 10% to 20%. A sharp rise was noted from 2010 to 2011, with a 36% increase, and another substantial jump from 2011 to 2012 at 16%.

From 2019 to 2022, India's pharmaceutical exports experienced a pronounced surge, likely driven by global demand during the COVID-19 pandemic. Exports rose by approximately 13% in 2020 and 19% in 2021, continuing robustly through 2022 with a 3.5% increase from the previous year. The percentage share of pharmaceutical products in India's total exports increased steadily over the past two decades, from 2.34% in 2005 to 6.69% in 2020, representing an overall increase of 4.35%. This upward trajectory, especially pronounced in 2020-2022, can be partly attributed to the global demand for COVID-19 vaccines and medical supplies, which India produces in large quantities.

India's pharmaceutical exports continued to grow in 2023, reaching $21.30 billion, marking a 7.5% increase from 2022. While the post-pandemic surge in medical exports has moderated, the sustained growth reflects India's strengthening position in the global pharmaceutical supply chain. The sector's performance remains robust despite global trade disruptions, with factors such as increased foreign investment and policy support further driving expansion.

The analysis of India's pharmaceutical exports from 2003 to 2023, based on different HS codes, reveals significant growth across the board. Specifically, the value of exports for HS 3004

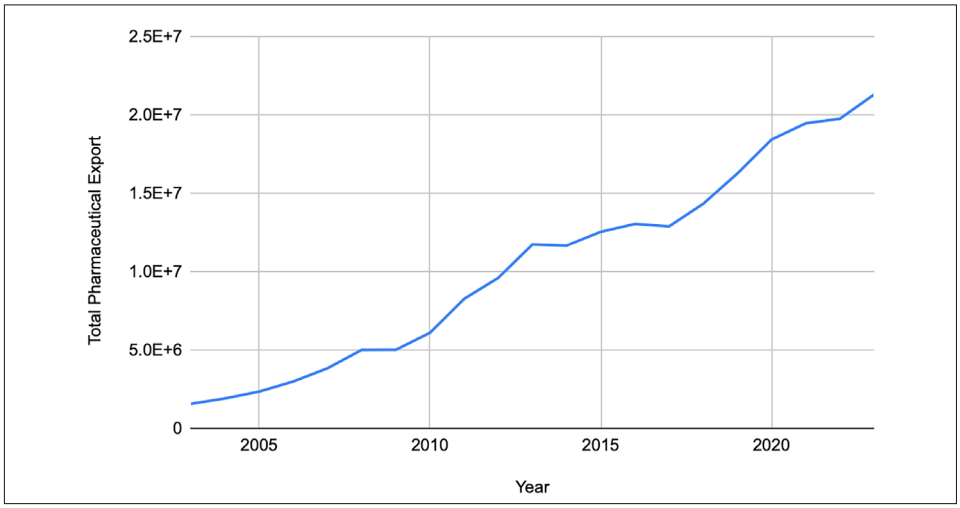

Figure 7. India's total pharmaceutical export 2003-2023 (US$ Thousands)
Source: International trade center (2024)

(which includes medicinal products intended for oral administration) increased by approximately 1490.63%, while HS 3001 (medicinal products in forms like tablets or capsules used to treat conditions such as digestive issues or heart problems) saw a rise of about 1243.63%. Notably, HS 3006 (veterinary medicines used for treating animals, such as antibiotics and vaccines for pets or livestock) experienced an impressive growth of approximately 1707.42%.

HS 3002 (inject able medicines such as vaccines and serums used for immunization or other medical treatments) recorded the highest increase, with a surge of around 2152.66%, reflecting the increasing global demand for vaccines and inject able treatments. In contrast, HS 3003 (hormonal medicines or biological agents used for therapies like hormone replacement or birth control) had a more modest growth of 33.96%, while HS 3005 (topical treatments like bandages and ointments used to treat wounds or burns) saw an increase of approximately 637.09%.

These substantial increases indicate a robust expansion in India's pharmaceutical export sector over the past two decades, with particularly strong growth in products categorized under HS codes 3002 and 3006, reflecting their rising value and importance in global markets. The continued growth in 2023 further solidifies India's role as a key player in the global pharmaceutical supply chain. In conclusion, it can be said that India majorly exports drug formulations & biologicals, and these products contribute to about 75% of the total pharmaceutical exports out of India.

The figure below illustrates India's country-wise pharmaceutical exports in 2023, providing a clear picture of the distribution across various countries. The U.S. stands out as the dominant market, accounting for a substantial 35.45% of India's pharmaceutical exports. This overwhelming share underscores the significance of the U.S. market for India's pharmaceutical industry. Other countries account for much smaller shares in comparison. The United Kingdom is the second-largest importer at approximately 3%, followed closely by South Africa at 2.93%, the Netherlands at 2.49%, France at 2.37%, Nigeria at 2.12% Canada, Australia, Belgium and Brazil all at approximately 2%. These countries, while important, collectively make up about 20% of the export market, highlighting the heavy reliance on the U.S. market. Comparing the previous findings with the U.S.'s country-wise share of pharmaceutical imports in 2023. Ireland is the leading exporter, accounting for 20.26% of the U.S. pharmaceutical imports,

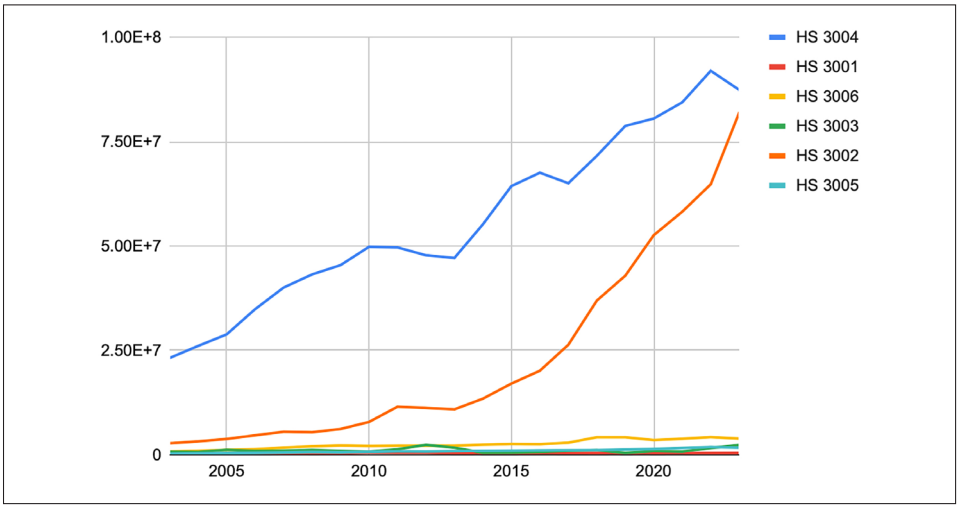

Figure 8. India's pharmaceutical exports based on different HS codes (2003-2023)
Source: International Trade Center (2024)

followed by Germany at 10.75% and Switzerland at 8.48%. These three European countries collectively account for over 39% of U.S. pharmaceutical imports, indicating a strong reliance on high-quality pharmaceutical products from Europe. Other significant exporters include India (6.17%), Singapore (5.31%), and Belgium (3.79%), showing their crucial roles in the U.S. pharmaceutical market. Italy contributes 4.55%, followed by the United Kingdom at 3.85%, Japan at 3.70%, and China at 3.37%, reflecting the global nature of the pharmaceutical supply chain for the U.S.

The comparison between the two figures underscores the significance of the U.S. as a prime target market for India's pharmaceutical exports. The figure, illustrating the country-wise share of U.S. pharmaceutical imports indicates a diversified and highly competitive pharmaceutical market in the U.S. The U.S.'s consistent reliance on pharmaceutical imports suggests a sustained demand for high-quality medications from global suppliers. In contrast, the figure focusing on India's pharmaceutical exports reveals that the U.S. accounted for an overwhelming share of India's total pharmaceutical exports. This clearly demonstrates the U.S. dependence on Indian pharmaceutical products, particularly in the area of generic drugs, where India holds a competitive advantage due to its low-cost production capabilities and high manufacturing capacity. India's strong position in the U.S. market, especially as a leading supplier of affordable generic medicines, reflects the robustness of the existing trade relationship.

Given these insights, India should prioritize the U.S. market for its pharmaceutical exports. The U.S. is the largest global importer of pharmaceuticals (30-35%) and represents the highest-value market for Indian pharmaceutical exports (Sadam, 2025). With strong demand and India's established market share, there is a significant opportunity to expand further. The increasing healthcare needs and rising prescription drug prices in the U.S. are driving demand for cost-effective alternatives (National Academies of Sciences, Engineering, and Medicine, 2018), which India is well-equipped to provide. India's reputation for high-quality generic medicines aligns with the U.S. goal of reducing healthcare costs while ensuring access to essential medications (Department of Pharmaceuticals, 2023b). By focusing on the U.S. market, India can strengthen export growth, enhance trade relations, and solidify its competitive position in the global

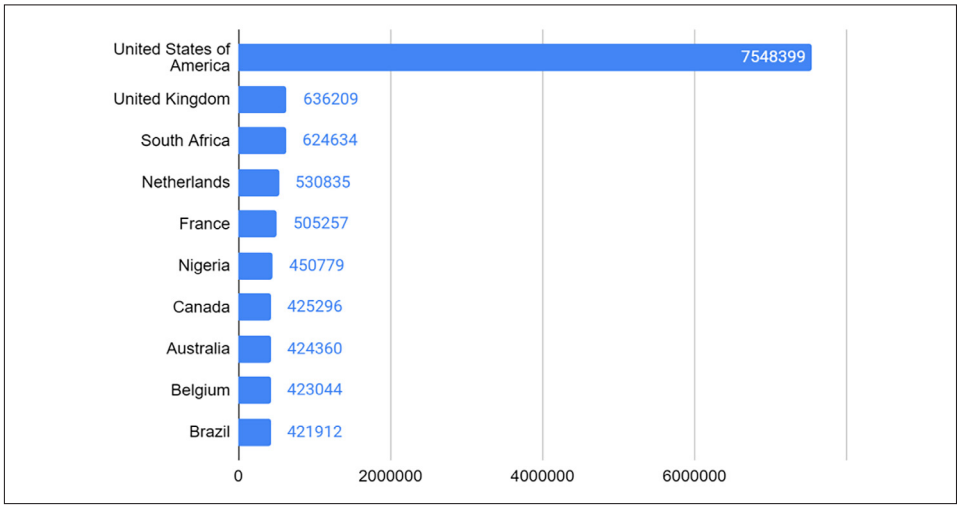

Figure 9. India's country-wise share of pharmaceutical export 2023 (US$)
Source: International Trade Center (2024)

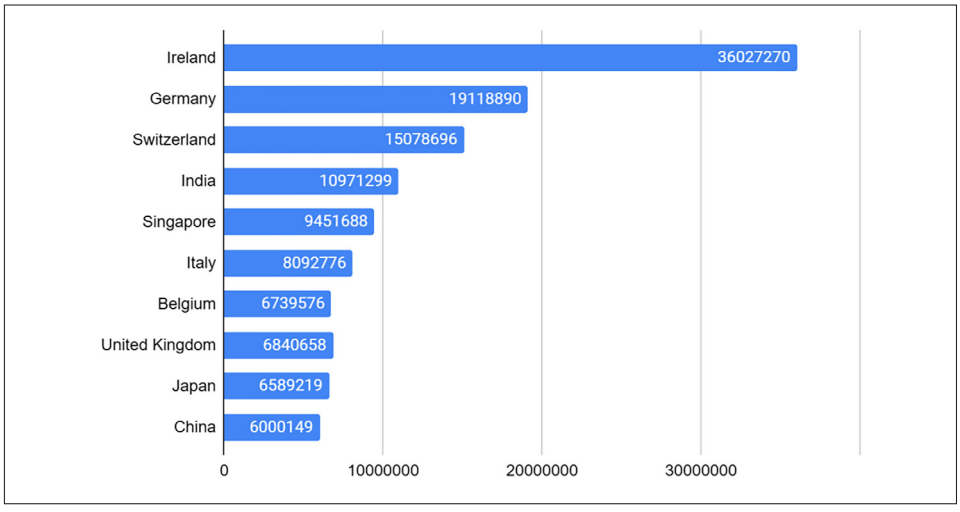

Figure 10. United States country-wise share of pharmaceutical import 2023 (US$)
Source: International Trade Center (2024)

pharmaceutical market, ensuring long-term economic benefits and sustained growth.

The figure below shows U.S. imports from various categories, identified by codes 3001, 3002, 3003, 3004, 3005, and 3006 from 2003 to 2023. The most prominent trend is represented by code 3004, which shows a steady and substantial rise in imports from 2005 until it peaks around 2020, followed by a slight decline and stabilization. This indicates a significant increase in demand for goods or services associated with code 3004 over this period. In contrast, imports related to the other codes (3001, 3002, 3003, 3005, and 3006) remain relatively flat throughout the timeframe,

suggesting that they contribute minimally to the overall import volume compared to code 3004. This stark difference underscores the dominant role that category 3004 plays in U.S. imports, while the other categories have seen little to no growth over the years.

Comparing the import data of the U.S. with India export data suggests that India's pharmaceutical export capabilities align well with U.S. import needs, particularly in HS Code 3004. The U.S. imports a large volume of these products, highlighting the strong match between India's export strengths and U.S. demand. This synergy suggests India's growing role in the global pharmaceutical supply chain, especially with government initiatives such as the PLI scheme boosting domestic production. This mutual compatibility indicates that India's pharmaceutical industry is well-positioned to meet the evolving demands of the U.S. market while capitalizing on its strong export capabilities.

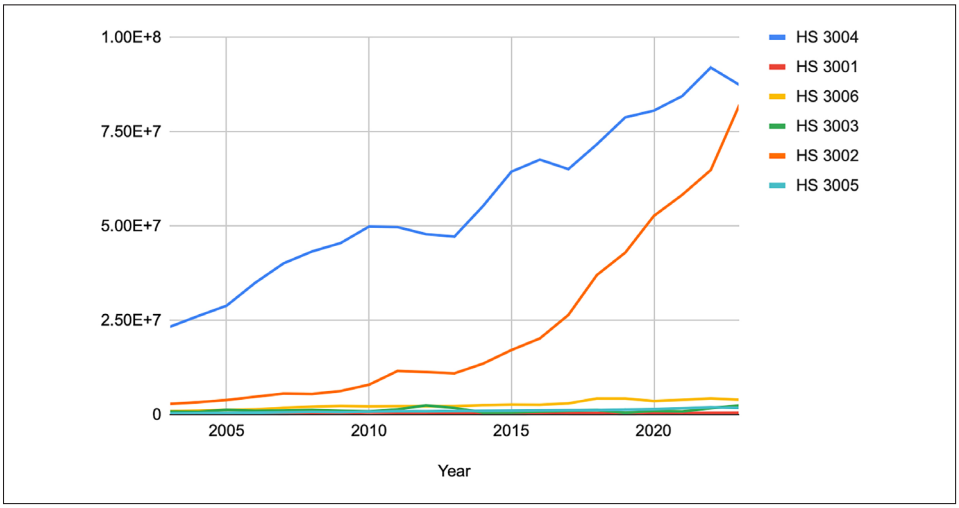

Figure 11. United States imports of different HS code from the world (US$ Thousands)
Source: International Trade Center (2024)

The graph below illustrates the percentage change in U.S. imports from China and India since 2003-2023, highlighting contrasting trends between the two countries. Initially, both countries saw growth in imports, with China experiencing a sharp increase in the mid-2000s, while India's growth was more gradual. From 2006 to 2010, China's imports fluctuated but remained positive, while India's growth slowed and stabilized. Between 2010 and 2020, imports from China showed consistent yet moderate changes, while those from India remained largely flat, with only slight fluctuations. A notable spike in U.S. imports from China occurred around 2020, likely due to trade disruptions caused by the COVID-19 pandemic, while imports from India remained largely unaffected. Afterward, U.S. imports from China saw a sharp decline, possibly linked to shifts in trade policies, while India's imports continued their steady trajectory. In summary, U.S. trade with China was more volatile, while trade with India remained stable throughout the years.

During the Trump administration (2017–2021), U.S.-China trade tensions led to tariffs on Chinese pharmaceutical imports, including active pharmaceutical ingredients (APIs), raising costs for U.S. manufacturers. Policies like the "Most Favored Nation" rule and efforts to boost domestic production reshaped the pharmaceutical trade, while the COVID-19 pandemic

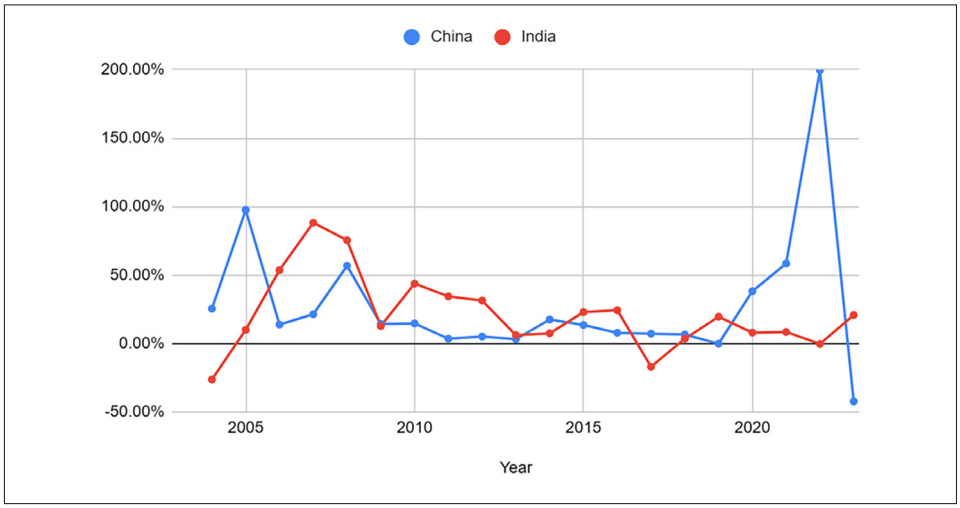

Figure 12. United States imports from China and India (Percentage change in value since 2003)
Source: International Trade Center (2024)

highlighted vulnerabilities in global supply chains, further motivating a reduction in reliance on Chinese imports (Brown, 2020). In 2018, the U.S. imposed phased tariffs, starting with a 25% levy on APIs and medical equipment, later extending to additional pharmaceutical products. However, critical medicines, vaccines, insulin, and certain APIs were exempted to prevent supply disruptions, especially during the pandemic (LGM Pharma, 2025).

An analysis of U.S. pharmaceutical imports from China and India (2003–2023) by HS Code in Fig. 13 and 14 below, reveals shifting trade patterns consistent with the China+1 strategy. In HS Code, China maintained a strong lead, rising to $165,265 in 2023, while India's exports remained minimal at $5,134. For HS Code 3002, China's exports peaked at $1,838,587 in 2022 but fell sharply to $451,611 in 2023. In contrast, India's exports rose steadily, reaching $199,254 by 2023, indicating increasing competitiveness in critical pharmaceutical inputs.

In HS Code 3003, China remained dominant ($159,136 in 2023), while India's exports declined from earlier levels to $89,623. A significant shift is observed in HS Code 3004, where India's exports rose from $197,635 in 2003 to $10,504,630 in 2023, overtaking China, whose exports declined to $4,473,279. While China maintained a wide lead in HS Code 3005, India's export share remained marginal. However, in HS Code 3006, India surpassed China by 2023, exporting $160,246 compared to China's $103,278. These trends suggest a gradual reconfiguration of U.S. pharmaceutical sourcing. While China remains dominant in several categories, India's expanding presence—particularly in APIs, dosed formulations, and preparations—reflects growing U.S. efforts to diversify supply chains under the China+1framework.

The stability of U.S. imports from India, in contrast to the volatility in U.S.-China trade, presents a significant opportunity for India in the U.S. market. While U.S.-China trade has been marked by fluctuations due to tensions, tariffs, and supply chain disruptions, India's steady import trajectory positions it as a reliable partner, particularly as U.S. businesses seek alternatives to Chinese imports. India's well-established pharmaceutical industry, particularly in generic drugs and APIs, makes it an attractive supplier as the U.S. reduces dependence on Chinese imports. As a leading global supplier of generic medicines, India's manufacturing strengths and cost-effectiveness make it well-equipped to capture an increasing share of the U.S. market. The shift

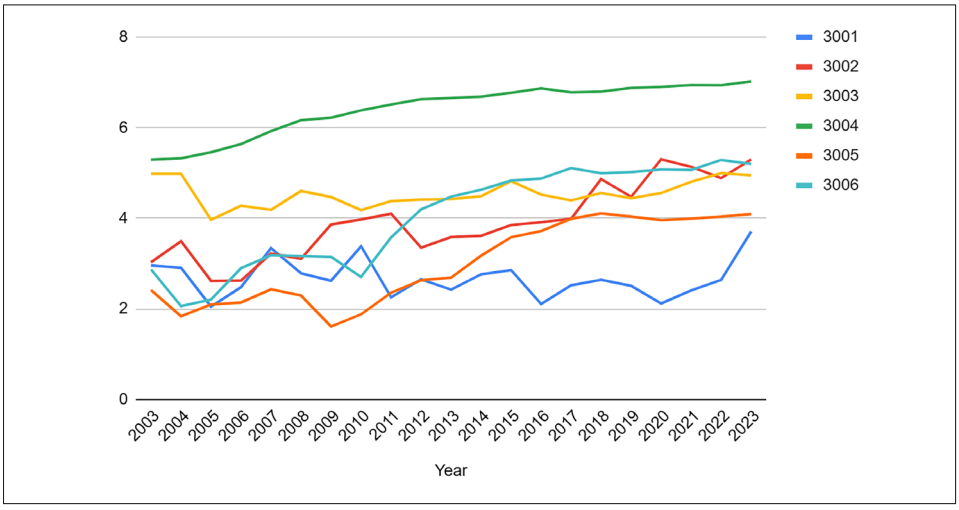

Figure 13. United States imports from India by HS code (2003-2023) log scale
Source: UN Comtrade (2025)

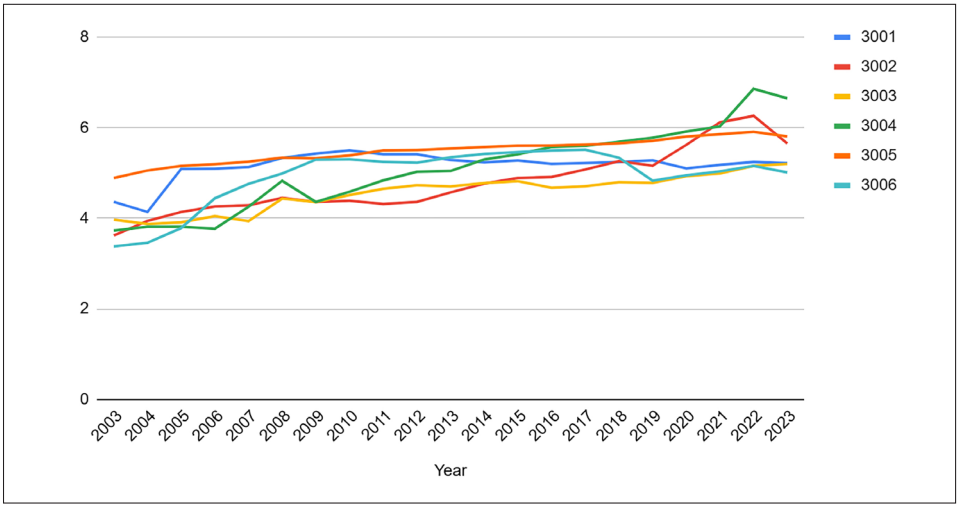

Figure 14. United States imports from China by HS code (2003-2023) log scale
Source: UN Comtrade (2025)

to diversify supply chains and reduce reliance on Chinese APIs offers India a clear opportunity to expand its role in supplying critical raw materials and finished pharmaceutical products to the U.S.

Methodology

To analyze the competitiveness of India's exports globally and in the U.S., we will calculate the RCA, MCA and CAC.

As the dynamics of the global market evolve, scholars such as Balassa (1965), Porter (1990), and Krugman (1994) have underscored the heightened significance of export competitiveness in the context of intensified market competition. Export competitiveness, intricately intertwined with the notion of comparative advantage, delineates a nation's capacity to efficiently market its goods on the international stage (Gupta, 2009; Ketels, 2010). Consequently, our study is centered on the computation of metrics RCA, CAC and MCA), all rooted in the principle of comparative advantage.

Originating from the seminal work of Balassa (1965), the RCA framework emerged as a methodological tool for gauging a nation's relative advantage in a specific product within the global marketplace, grounded in its market share. Revealed Comparative Advantage is one of the most widely used index to calculate the comparative advantage of a commodity in the world market. RCA index value lies between 0 to ∞ where an RCA value < 1 indicates that a country has a comparative disadvantage in a specific commodity, meaning it exports that product less intensively than the global average and is relatively less competitive in the world market. Conversely, an RCA value > 1 signifies a comparative advantage, showing that the country exports the product more intensively than the global average and is relatively more competitive internationally (Balassa, 1965).

$$RCA_{ij} = \frac{\frac{X_{ij}}{X_j}}{\frac{WX_i}{WX}}$$

X_{ij} = Country j's total export of products in the world
X_j = Country j's total exports in the world
WX_i = World exports of product i
WX = Total world export

The concept of MCA was introduced by Kim et al. (1997) which was a slightly modified version of RCA. Unlike RCA, MCA calculated the competitiveness of a commodity in a specific market. Similar to RCA, the MCA value lies between 0 to ∞. If the value is < 1, the country is said to have a comparative disadvantage compared to average exports of specific products to the market in the commodity and vice versa.

$$MCA_{ij} = \frac{\frac{X_{ij}^k}{X_j}}{\frac{WX_{ik}}{WX_k}}$$

X_{ij}^k = Country j's exports of product i to the marker k
X_j = Country j's total exports to market k

WX_{ik} = World exports of product i to the k market
WX_k =Total world exports to the k market

The concept of CAC was also introduced by Kim (2009). It also has an index value between 0 to ∞. If the value is >1, the country is said to have a comparative advantage in the commodity compared to average exports of specific products in the world and vice versa

$$CAC_{ij} = \frac{\frac{X_{ij}^{k}}{X_j}}{\frac{X_{ik}}{X_i}}$$

X_{ij}^{k} = Country j's exports of product i to the k market
X_j = Country j's total exports to the k market
X_{ik} = Country j's total exports of products i in the world
X_i = Country j's total exports in the world

Data Source:

Data on India's pharmaceutical exports to the U.S. were sourced from the International Trade Center (ITC) database, using four-digit HS Codes for pharmaceutical products. The study period spans from 2003 to 2023, chosen for its significance in examining India's pharmaceutical export competitiveness in the context of the China+1 strategy. After 2003, India increasingly became a prominent player in global pharmaceutical exports, largely due to the TRIPS agreement, which facilitated the expansion of generic drug production (Loitongbam, 2016). This period also coincides with the rise of the China+1 strategy post-2010, when companies began diversifying supply chains away from China due to geopolitical tensions and events such as the COVID-19 pandemic. As a result, India emerged as a key alternative supplier, particularly in APIs, an area where China had previously dominated. Moreover, India's introduction of the PLI scheme in 2020 aimed to strengthen domestic pharmaceutical manufacturing and reduce reliance on Chinese imports (Das, 2023). These combined factors, along with evolving trade relations between India and the U.S., make the 2003-2023 period particularly relevant for understanding India's potential to benefit from the China+1 strategy and enhance its pharmaceutical exports to the United States.

Results

This section analyzes the RCA, CAC, and MCA of India's pharmaceutical exports to the U.S. region. RCA shows the comparative advantage in the global market by measuring the export share of a country's commodity in the global market concerning the share of the respective countries' exports in world exports. Secondly, the CAC reports the export performance of Indian pharmaceutical products in the US market concerning India's export performance in the global market. Lastly, the MCA illustrates India's comparative advantage in the U.S. by calculating the share of exports of goods in India's exports to the U.S.

Table 1. Category of Pharmaceutical products based on four-digit HS codes

HS Code	Description
3004	Medicaments consisting of mixed or unmixed products for therapeutic or prophylactic uses, put ...
3001	Dried glands and other organs for organo-therapeutic uses, whether or not powdered; extracts ...
3006	Pharmaceutical preparations and products of subheadings 3006.10.10 to 3006.93.00
3003	Medicaments consisting of two or more constituents mixed together for therapeutic or prophylactic ...
3002	Human blood; animal blood prepared for therapeutic, prophylactic or diagnostic uses; antisera ...
3005	Wadding, gauze, bandages and the like, e.g. dressings, adhesive plasters, poultices, impregnated ...

Revealed Comparative Advantage

The RCA metric is used to evaluate the comparative advantage of Indian pharmaceutical products in the global market. It is based on the premise that international competitiveness, rather than demand in a foreign market, drives an increase in export share (Kim, 2009).

Fig. 15 illustrates India's RCA of 4-digit HS Code pharmaceutical products in the global market from 2003 to 2023, highlighting varying degrees of competitiveness across product categories. Among all, HS Code 3002 consistently demonstrates the highest comparative advantage, with RCA values peaking at 9.09 in 2021 and maintaining a robust position at 8.88 in 2023 despite significant fluctuations. HS Code 3004 also exhibits a strong and growing comparative advantage, as its RCA increased from 1.02 in 2003 to a peak of 2.63 in 2020 before stabilizing at 2.25 in 2023. HS Code 3003, while still being comparatively advantageous, shows a continuous decline with its RCA falling from 6.72 in 2003 to a peak 1.34 in 2023. On the other hand, the RCA values of HS Code 3001, 3005 and 3006 all depict a comparative disadvantage. HS Code 3005 moved from being comparatively advantageous with an initial peak of 1.48

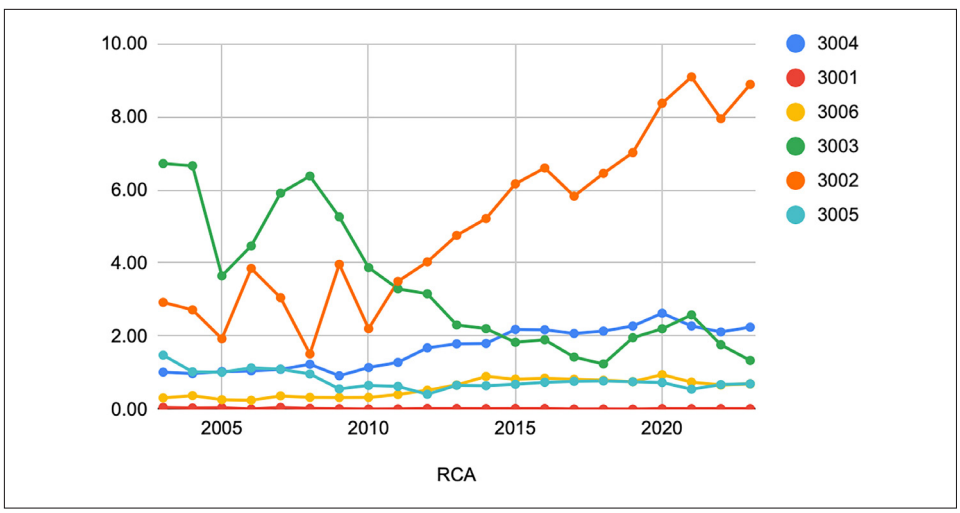

Figure 15. RCA of HS code 30 (4 digits)
Source: Authors calculation

in 2003 to reaching 0.70 in 2023. Conversely, HS Codes 3006 and 3001 continuously reflect a comparative disadvantage, with RCA values remaining very low. Although HS Code 3006 showed a marginal improvement to 0.70 in 2023, it still lacks a competitive advantage, while HS Code 3001's RCA stayed between 0.01 and 0.06, standing at 0.02 in 2023.

Comparative Advantage by Countries

The analysis of CAC values which shows how well Indian pharmaceutical products are doing in the US market compared to how they perform in the global market. If the CAC is high, it means India is particularly strong in selling those products in the US compared to other countries. If it is low, it suggests that India's performance in the US is not as good as in the rest of the world. HS Codes 3001, 3004, 3005, and 3006 exhibit strong and often increasing CAC, with HS Code 3001 peaking at 6.49 in 2014 before slightly declining but maintaining a value of 4.10 in 2023. HS Code 3004 consistently shows robust performance with values above 1, indicating sustained competitive advantage in the U.S. market. HS Code 3005 maintains comparative advantage post-2007, with its value fluctuating but reaching 1.31 in 2023. HS Code 3006 shows marked improvement in recent years, peaking at 3.11 in 2016 and recording 2.26 in 2023. Conversely, HS Codes 3002 and 3003 face challenges, with 3002 persistently below 1, signifying comparative disadvantage in the U.S. market.

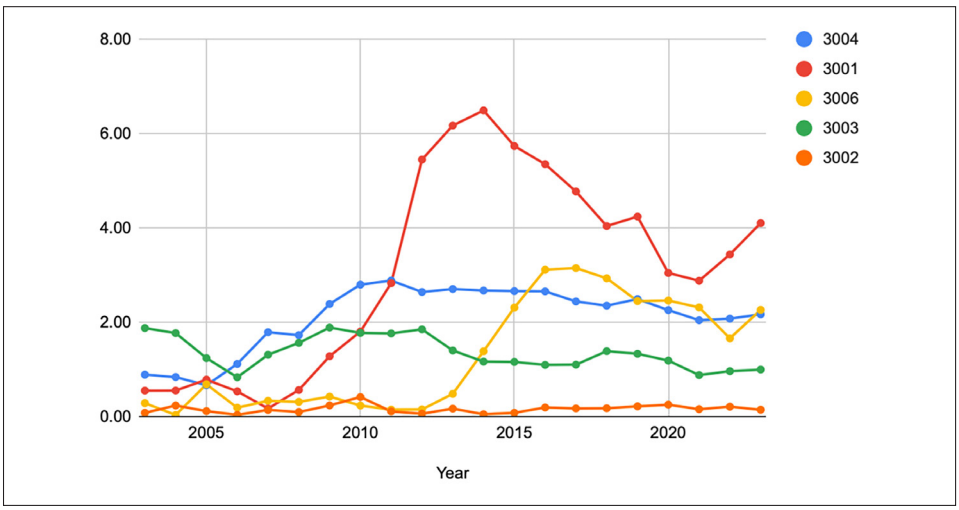

Figure 16. CAC of HS code 30 (4 digits)
Source: Authors calculation

Market Comparative Advantage

The MCA illustrates India's comparative advantage in the U.S. by calculating the share of pharmaceutical exports in India's exports to the U.S. in relation to the U.S. import share of the commodity in total world imports. Because India is among the top ten exporters of pharmaceutical products to the U.S., it is evident for the MCA to have a larger value than the CAC. The figure below explains India's MCA of HS Codes 3001~3006 in the U.S. market. The analysis of the MCA values from 2003 to 2023 for various HS Codes reveals critical insights into India's pharmaceutical export performance in the U.S. market. HS Codes 3001, 3004, and

3003 consistently exhibit strong comparative advantages, with HS Code 3004 maintaining values above 1 and reaching 4.08 in 2013 before stabilizing at 3.48 in 2023. HS Code 3001 demonstrates significant growth, rising from 1.08 in 2003 to 7.38 in 2023, while HS Code 3003 exhibits exceptional performance, peaking at 16.34 in 2004 but gradually declining to 1.14 in 2023, indicating a decrease in its comparative advantage. Overall, the findings indicate that the products under HS Code 3001, 3004 and 3003 have a strong competitive advantage over other markets in the U.S.

Conversely, HS Codes 3002 and 3005 consistently show comparative disadvantages, with values remaining below 1, underscoring their weak positions in the U.S. market. HS Code 3006 fluctuates, with occasional peaks above 1, suggesting potential but inconsistent competitive performance, reaching 1.09 in 2023.

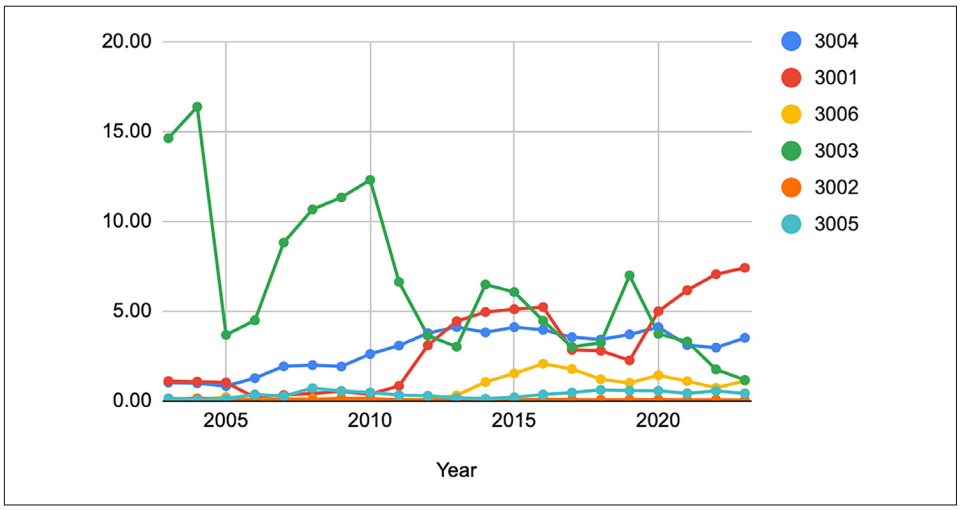

Figure 17. MCA of HS code 30 (4 digits)
Source: Authors calculation

Conclusion

The findings suggest that India's pharmaceutical exports show varying levels of competitiveness across different product categories in both the global and U.S. markets. Of the three indicators examined, only those goods classified under HS Code 3003 and 3004 enjoy a comparative advantage in both the world and U.S. markets, indicating the strong position of Indian exports in this class. This is supported by recent trade data, which shows that India has not only maintained but expanded its presence in these categories, with HS Code 3004 exports to the U.S. surpassing those from China in 2023. These results underscore the strategic potential of these segments for India's long-term export focus.

India's competitiveness in pharmaceuticals is rooted in several key strengths: a cost-effective generic drug manufacturing base (Chatterjee, 2021), a skilled workforce, and growing R&D capacity (IBEF, 2023). Moreover, certification by global regulatory bodies like the U.S. FDA enhances India's access to regulated markets (Huang et al., 2021). These advantages have been

further supported by government initiatives such as the PLI scheme and targeted R&D funding (Department of Pharmaceuticals, 2020).

These strengths align closely with the China+1 strategy, which gained momentum due to rising labor costs in China, geopolitical tensions, and supply chain shocks during the COVID-19 pandemic (Hancock & Mora, 2023; Rahaman et al., 2021). As multinational corporations reassess the risks of overreliance on China, India is increasingly seen as a viable alternative in the pharmaceutical sector. Its democratic governance, policy reforms, and manufacturing scale make it an attractive "Plus-One" for countries like the U.S. seeking to diversify supply chains (Fajgelbaum et al., 2024; Wolf, 2020).

A closer look at India's performance in the U.S. market reveals a more nuanced picture. For instance, while HS Code 3002 carries the highest RCA value globally, it lacks competitiveness in the U.S. market, as shown by CAC and MCA values below 1. This suggests regulatory barriers or heightened competition. To address these gaps, India must invest more in product-specific R&D, improve regulatory compliance, and adopt differentiated export strategies.

In contrast, HS Codes 3001, 3005, and 3006 exhibit strong U.S. market performance but remain weak globally, pointing to the potential for targeted expansion into markets with similar demand patterns. Meanwhile, HS Code 3002 shows underperformance across all three indicators, signaling a broader competitive disadvantage.

Overall, India's stronger competitive position in the U.S. market relative to global performance reinforces the relevance of the China+1 strategy. The evolving U.S.-China trade relationship—particularly under the renewed Trump administration—may intensify this shift. Should tariffs and scrutiny on Chinese pharmaceutical exports be reinstated, India could be well-positioned to capture greater market share. Existing policy frameworks such as Pharmexcil, the NPPA, the "Make in India" initiative, and the PLI Scheme can further bolster India's export competitiveness by enhancing market access, regulatory alignment, and domestic production capacity.

However, the study also highlights that India's strengths in the U.S. market do not consistently translate to global leadership. Rather than a uniform export policy, a segmented approach tailored to product-specific and market-specific dynamics is required. Enhanced trade negotiations, supply chain resilience, and technology investments will be critical for sustaining India's global competitiveness.

Future research should expand beyond the U.S. to assess India's export potential in other major markets. Comparative studies with other leading pharmaceutical exporters could uncover best practices and guide strategic positioning in the evolving global trade landscape.

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Notes

1. In this study, *geopolitical shifts* refer to changes in the global trade environment driven by international political tensions, such as the U.S.–China trade war, strategic decoupling, export restrictions, and realignments of trade partnerships. These developments influence supply chain decisions, trade flows, and investment patterns, particularly in critical sectors like pharmaceuticals.
2. The CEP is a certificate that certifies compliance of the API or pharmaceutical ingredients with that of the rules laid down in the monograph of the European Pharmacopoeia (EP).
3. The year 2019 is the latest data that can be accessed.

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