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Changing Dynamics of Indian Pharmaceutical Sector: Opportunities and Challenges

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Abstract: COVID-19 pandemic has disrupted the supply chains for global pharmaceutical companies; however, it has also provided an opportunity for countries like India to expand their share in global drugs & pharmaceutical exports by leveraging its existing strengths. The Indian pharmaceutical sector has established itself as the pharmacy of the world, being the largest provider of generic drugs and amongst the biggest supplier of low-cost vaccines. This paper attempts to understand the possible dynamics of the pharmaceutical sector, focusing on export opportunities and challenges for India. While India has successfully expanded production capacity in case of personal protective equipment in a very short period, other areas, including diversification of suppliers and moving up in the value chain, will require sustained efforts. An empirical analysis using firm-level panel data of 67 pharmaceutical firms has been undertaken to identify the factors impacting export competency. Empirical results confirm the import dependency of Indian pharmaceutical firms on raw materials. They also reveal the importance of investment in research & development and higher capital outlay in boosting exports.

Keywords: Pharmaceutical sector, COVID-19 pandemic, India, Exports, APIs, Government policies

JEL: F10, F14, I18, O30

1. Introduction

In the past years, the world has witnessed sustained threats of outbreaks and pandemics. The COVID-19 pandemic has caused an unprecedented health crisis and continues to rage in many locations, including bouts of resurgence. Given the

widespread health, economic, and social consequences of the pandemic, the world is looking up to the medical goods industry to provide vaccines for prevention/ recovery from the virus. Given the growing global demand for medical goods, this paper examines the developments in global medical products trade, focusing on India's pharmaceutical sector.

The earliest establishment of the modern pharmaceutical industry in India was a part of national movement to establish a scientific-oriented industry in India. However, the share of Indian pharma companies remained limited. The market was dominated by foreign-owned companies, as industry had little domestic technological base to start local production of modern drugs (Chandra, 2016; Bugalya & Kallummal, 2012). The amendment of the Patent Act of 1911 in 1970 and other domestic policies brought a renaissance to Indian Pharmaceutical sector through large scale production of bulk drugs both by public sector enterprises and the newly established private sector players[2].

Over the last five decades, the Indian pharmaceutical sector has undergone several policy changes, from the patent regime in the seventies to policies compatible with the TRIPS agreement. Today, the Indian pharmaceutical industry is one of India's most vibrant knowledge-driven industries that has witnessed consistent growth over the past three decades. The importance of drug & pharmaceutical sector can be gauged through its increasing share in country's total exports, which has witnessed a secular rise from 2 per cent in 1997-98 to around 8 per cent in 2020-21. Moreover, the Indian pharmaceutical sector is expected to grow to US$ 100 billion, and medical device market is expected to grow to US$ 25 billion by 2025.

Certain recent developments in the Indian pharmaceutical industry have also attracted global attention. The first is related to Personal Protective Equipment (PPE) products, where India has been able to successfully ramp up domestic production rapidly, which has allowed it to transform from an importing nation to exporting nation within a short period. Second, while currently, India has a large dependency on Chinese Global Value Chains (GVCs) for Active Pharmaceutical Ingredients (APIs), it has initiated efforts to diversify its imports to reduce the risk from any future supply-side disruptions. Thirdly, Indian firms have been at the forefront of COVID-19 vaccine manufacturing efforts are expected to play a crucial role in global vaccination efforts.

With the growing demand for medical products worldwide, it's imperative to understand the opportunities and headwinds that the Indian pharmaceutical sector

faces. According to recent research, India has emerged as a major producer and exporter of not just bulk drugs and formulations but also for other medical supplies and provisions as well (Ahmed *et.al* 2020). The recent policies accorded priority to boost research and development (R&D), original design capabilities for the pharmaceutical sector through production linked incentive (PLI) scheme to harness its export potential to maintain the competitive edge in the global market.

Indian pharma sector exports have grown rapidly in recent decades on the back of Indian pharma firms' enormous success in establishing themselves in developing economies as reliable and cost-effective providers of medicines. However, at the same time, their failure in establishing themselves in the major pharma importers, which are majorly developed economies, ascertains closer analysis. Further, the COVID-19 pandemic and the ensuing disruption to global economy and supply chains have led to increased scrutiny over the risks faced by the pharmaceutical industry. At the same time, the drugs & pharma sector are crucial for the revival of the global economy. In this context, the analysis of determinants of pharma exports has gained profound relevance. While the demand-side factors play a vital role in determining India's export performance, supply-side factors are also critical in ensuring the sustainability of export performance.

Given the background, the paper is organised into the following sections. Section II provides a brief overview of related literature. Section III presents the stylised facts and analyses the global medical export market along with the key strength and weaknesses of Indian pharma industry. Section IV undertakes an empirical analysis using firm-level data to determine the factors impacting the export performance of Indian pharmaceutical firms. Finally, Section V provides a concluding view.

2. Literature Review

Much of India's country's pharmaceutical consumption was met by imports until the early 1970s. Between 1947-57, 99 per cent of the 1704 drugs and pharmaceutical patents in India were held by foreign MNEs, which controlled 80 per cent of the market, leveraging on new therapeutic developments in the Western economies (Aggarwal, 2006; Kumar & Prakash Pradhan, 2012). The amendment of the Patent Act of 1911 in 1970, along with other changes in domestic policies, brought a renaissance to Indian Pharmaceutical sector through large scale production of bulk drugs both by public sector enterprises and the newly established private sector players[3]. Further liberalisation measures in the pharmaceutical sector bought through

major changes in the industrial licensing policy, import restrictions, foreign direct investment, and production controls in post-reform period have allowed to unlock the potential of the sector (Aggarwal, 2006; Biswajit Dhar, T C James, & Reji K Joseph, 2012; Chakraborty & Ghose, 2017; Manju & Sharma, 2020; Ravinder Jha, 2007). As a result, pharma exports had grown nearly ten-fold between 1991 and 2008, with drugs & pharma exports being valued at close to US$ 5 billion in 2007-08.

In recent decades Indian pharmaceutical firms have shifted their focus from low-value bulk drugs and intermediates to relatively higher value formulation exports in a bid to capture a larger share of value addition (Akhtar, 2013; Joseph, 2009). This has resulted in share of domestic value-added content in foreign final demand to go up by 6.2 percentage points in a decade from 32.6 per cent in 2005 to 38.8 per cent in 2016 (Export-Import Bank of India, 2019). This has also impacted the trade profile, where exports of formulations have increased nearly twenty-fold during this period, while that of bulk drugs have only increased five-fold. Thus, while bulk drugs exports were nearly double that of formulation drugs exports in 1990-91, the situation entirely changed in 2007-08. Drug formulation exports were almost double the size of bulk drug exports (Joseph 2009). Further, the imports of bulk-drugs have increased at a rapid pace, to compensate for the shift in focus away from production of bulk-drugs to formulations, with the imports of APIs being estimated to have risen at a CAGR of 11 per cent between 2004 and 2016 (CII, 2017). Simultaneous decline in domestic production of bulk drugs and a growth in imports has created vulnerability which is being viewed with increasing concern (James, 2020; Joseph, 2012).

Literature also notes another area of concern for Indian pharmaceutical sector is low expenditure on research and development (R&D). Analysis of pharmaceutical sector literature suggests that the global pharmaceutical industry is a highly capital-intensive industry due to massive capital outlays on R&D[4]. According to a report by Mckinsey, "given the capital-intensive nature of pharma R&D, firms require a stable backbone of technical competencies in any R&D operating model"[5]. Unlike other industries, pharmaceutical companies are under constant pressure to develop new and innovative products. A number of studies have analysed the change in the performance of firm's output due to a change in firm's R&D expenditure (Griliches 1986, 1994; Mansfield 1988; Griffith 2006). Globally, compared to other sectors, the pharmaceutical industry has by far the highest R&D expenditures per employee.

Company's revenue and R&D spending together is seen as company's capability to generate outputs. Initially, firms emphasised exploring and developing new processes in order to manufacture drug. With time, firms engage aggressively in R&D for development of new chemical entities intending to develop new formulations (Sharma C. 2012). The literature points towards a large variation in elasticity estimates due to differences in industry type or whether the analysis is at a firm or industrial level.

The role of R&D in impacting export performance, especially in technology-intensive industries like pharmaceuticals, has also been well established in the literature. Kumar and Siddharthan (1993) note that in high technology industries, such as pharma, a higher degree of capital intensity provides a competitive advantage in exports. Ganguli (2007) also pointed out that capital intensity has a significant and positive impact on Indian export performance. Rentala *et.al* (2014) found similar results for the Indian pharmaceutical industry. A recent study by Bhat and Momaya (2020) finds that improved capabilities in innovation contribute to superior export performance. Both for developed and developing countries, expenditure on R&D positively impacts export performance. The research also notes the importance of firm size, which significantly strengthen firm's exports performance.

Roberts *et.al* (1997) documents that most productive firms find it profitable to operate in the exports market and incur a sunk cost. Firms earning large profits could face immense competition in exporting market. Melitz (2003) notes that firms which produce above the export productivity cut-off are able to export. Srinivasan and Archana (2011) established a positive and significant relationship between profitability and exports. Fryges and Wagner (2008) found that a positive profitability difference between exporting and non-exporting German firms.

3. Stylised Facts

3.1 Global Medical Export Market

The global medical export market at USD 995.8 billion contributed nearly 6 per cent in global merchandise exports in 2019 (World Trade Organization, 2020). The disaggregation of global medical products exports reveals that medicines have the largest share in global medical exports of 56 per cent, while medical supplies, medical equipment and personal protective products have a share of 17, 14 and 13 per cent, respectively (Chart 1a). The composition of top exporters of medical products in

2019 suggests that Germany is the leading exporter (with a share of 14 per cent in global exports), followed by the United States, Switzerland, and China (Chart 1b). Further, the export market for medical products is concentrated as nearly three-quarters of world exports in medical products are contributed by the world's top 10 exporters. Medicines make the largest component of country's medical exports for a majority of countries, especially for countries such as Switzerland, Italy, and India, where it accounts for more than three-fourth of its medical exports.

Chart 1a: Total Medical Product Exports (2019)-US$ billion

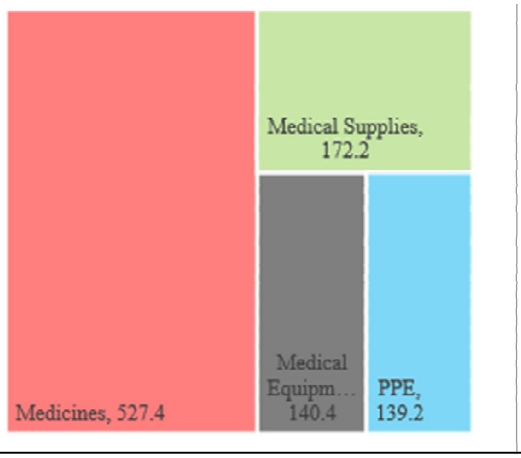
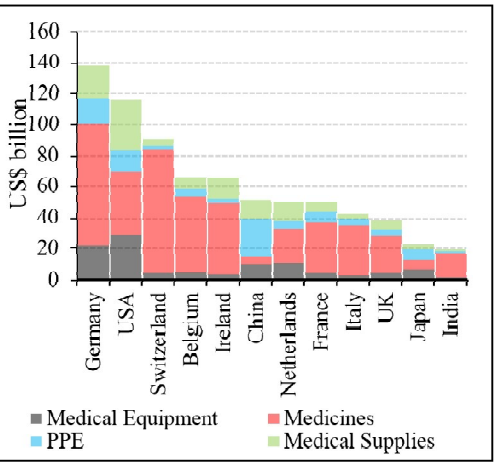


Chart 1b: Medical Products Exports-Top Exporters (2019)



Source: UN Comtrade.

The current pandemic has emphasised the production and trade of certain medicines and medical supplies. While the COVID-19 pandemic has taken its toll on the global economy and international trade, with global merchandise trade estimated to have contracted in double-digit, trade-in medical goods, perhaps not surprisingly, has surged by 15.4 per cent in H1:2020. This increase in medical goods trade is led by the sharp rise of 27.3 per cent in the trade of medical products considered critical in fight against COVID-19, especially products like face masks and respirators (Table 1). The reduction in trade restrictions, including tariffs, has been argued to promote trade in medical goods and ensure equitable access.

2.2. Trend in India's Pharma Exports

India has become the 12th largest exporter of medical products with a share of nearly 2.0 per cent in the global market in 2019. This can be attributed to the rapid

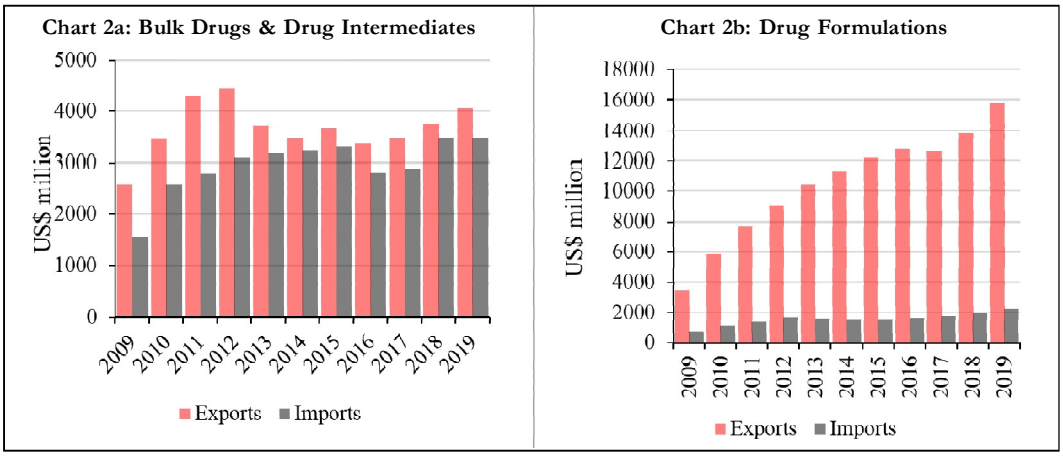
Table 1: Exports of Medical Goods Pre and Post COVID-19

Product category	*Value (US$ billion)*			*Growth rate (per cent)*	
	2018:H1	*2019:H1*	*2020:H1*	*2019/18*	*2020/19*
All medical products	480.6	489.3	564.4	1.8	15.4
Medical Equipment	66.4	67.7	70.5	2	4.2
Medical Supplies	83.6	85.4	94.1	2.2	10.1
Medicines	261.5	267.4	298.7	2.3	11.7
Personal Protective Products	69.2	68.8	101.2	-0.6	47.1
COVID-19-critical products	146.9	148.6	189.1	1.2	27.3

Source: WTO.

growth seen in case of pharma exports, especially of drug formulations (medicines), in the past decade, with exports of drug formulations growing at a cumulative annual growth rate of 16.2 per cent from nearly US$ 3.5 billion to US$ 15.8 billion in 2019. Thus, medicine exports (drug formulations) are the largest constituent in India's medical goods export basket, accounting for nearly 80 per cent of medical goods export basket. Further, the growth in formulations has been accompanied by a shift in the focus towards manufacturing and subsequently exporting of drugs & formulations. In line with the literature, drugs formulations exports have grown to nearly four times the size of export of bulk drugs & drug intermediates in 2019, continuing the trend seen in earlier years (Chart 2a and 2b).

Chart 2: Trends in Pharma Trade

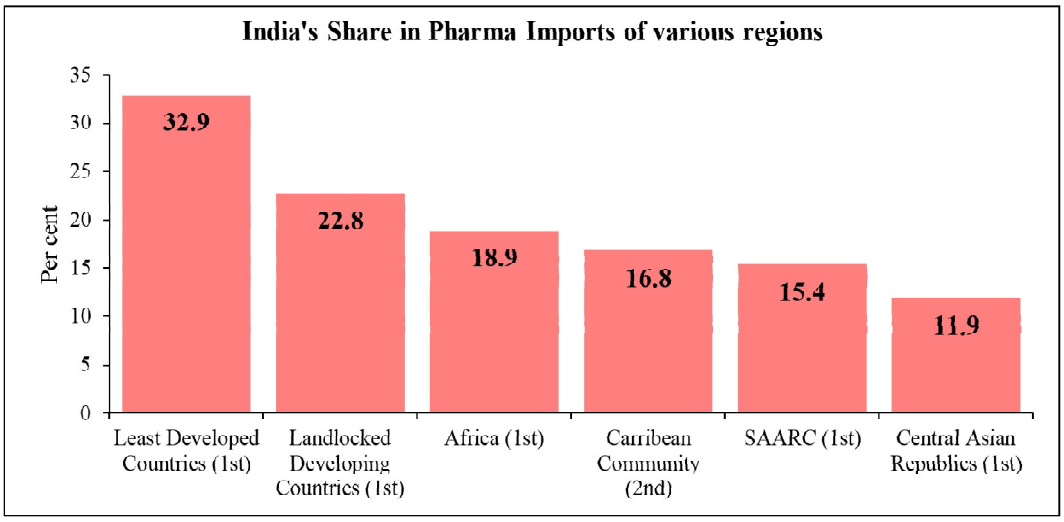


Further, in the crucial sub-sector of generic drugs[6], India is today the largest manufacturer of generic drugs by developing competency to provide generic drugs at an affordable cost (Akhtar, 2013; Horner, 2014). This has earned it the moniker 'pharmacy of the world', as today it is the 3rd largest exporter of medicines when seen in terms of volumes on account of exports of cost-effective generics (Department of Pharmaceuticals, 2019). Indian firms provide 20 per cent of the global supply of generics. Indian firms also account for around 40 per cent of the generic demand in the US and a quarter of Europe's. Furthermore, Indian manufacturers represent 67 per cent (379 of the 563) WHO prequalified pharmaceutical products for a range of conditions such as diarrhoea (1), hepatitis (13), HIV/AIDS (197), influenza (10), malaria (41), neglected tropical diseases (3), reproductive health (21), and tuberculosis (93) (Guerin, Singh-Phulgenda, & Strub-Wourgaft, 2020). India is the leading supplier of pharmaceuticals to developing countries, including those among Least Developed Countries, Landlocked Developing Countries, African Economies, SAARC, Caribbean Community and Central Asian Republics (Chart 3).

3.3. Research and development

The total global R&D expenditure of pharmaceutical companies increased from US$ 136 billion in 2012 to US$ 186 billion in 2019. The recent pandemic has further

Chart 3: India's Pharma Export Performance in Developing Countries



Figures in brackets represent India's ranking in various regions.

Source: ITC TradeMap.

highlighted the critical role of R&D for drug formulation. Governments globally have provided support for research and innovation need for faster development of COVID-19 vaccine. For instance, the USA allocated an overall US$ 18 billion to Operation Warp Speed (OWS) to speed up the process of development, distribution of effective vaccines. Government of India also announced Rs 900 crore (about US$ 120 million) towards COVID Suraksha Mission for research and development of the COVID-19 vaccine. Globally leading pharmaceutical firms too have undertaken expansion of R&D expenditure towards COVID-19 medicine. For example, Pfizer announced US$ 500 million for research, clinical development, and manufacturing of vaccines. The pharmaceutical sector globally is amongst the top investor in R&D, and with COVID-19 it is expected to play a crucial role as a leading R&D stakeholder. It is forecasted further that the pharmaceutical sector market is expected to grow by 160 per cent during 2017 and 2030 globally[7], and India will be the largest contributor to the growth (Chart 4a and 4b).

Chart 4a: Expenditure on R&D - Global Top Pharmaceutical Firm

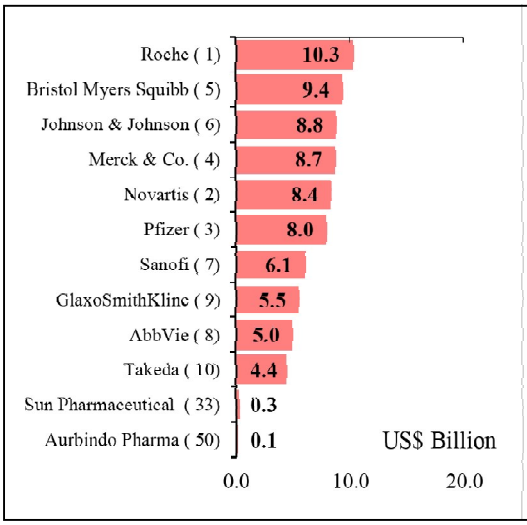
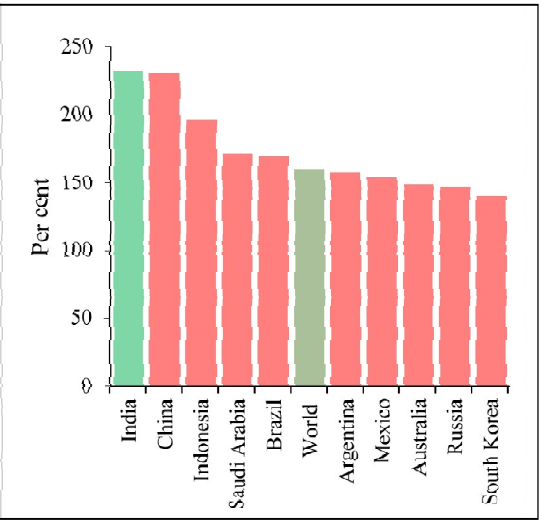


Chart 4b: Pharmaceutical sector growth forecast between 2017 and 2030 (in %)



Source: Statistica.

4.4. Key Challenge- High Bulk Drug Dependence

The COVID-19 pandemic caused disruptions in supply chains, highlighting the importance of diversification of trading partners particularly related to bulk drugs. India is highly dependent on China in case of bulk drugs, as the share of China in

the total bulk drug imports of India has gone up from 0.3 per cent in 1991 to 47.6 per cent in 2012 (T.C. James, 2015). This dependence has only increased further in recent years, with China accounting for nearly 70 per cent of India's total imports (Chart 5a). This shift from being self-sufficient in production of bulk drugs to being import-dependent on China can be attributed to the shift in focus of domestic pharmaceutical firms to relatively higher value products in the value chain, namely formulations/medicines, while importing APIs. On the other hand, Chinese manufactures have managed to carve out a comparative advantage in APIs, leveraging on less restrictive regulatory framework in the past, fiscal incentives and better infrastructure facilities combined with economies of scale (CII, 2017; James, 2020).

The initial outbreak of COVID-19 and the ensuing lockdowns imposed in Hubei, China, led to concerns over this dependence of Indian pharma industry on Chinese imports (Chatterjee, 2020). An analysis at 8-digit HS code level shows that India is highly dependent on China in 9 out of the top 10 bulk drugs and 65 out of top 100 bulk drugs (Chart 5b). Further, in case of many bulk drugs, India is totally dependent on China, with China's share being more than 90 per cent. China accounted for nearly 99 per cent of imports of 6-APA (6-Aminopenicillanic acid) which is used as a precursor for antibiotic compound amoxicillin, which is a broad-spectrum antibiotic and on WHO's list of essential medicines. Further, China accounted for nearly all of US$150 million, imports of penicillin and its salt, which are again an active ingredient for antibiotics (HS code 29411010).

To promote domestic production of APIs and reduce dependence on imports, a PLI scheme for promotion of domestic manufacturing of critical Key Starting Materials (KSMs)/ Drug Intermediates (DIs) and APIs have also been introduced to provide a financial incentive for manufacturing of 53 critical bulk drugs for a period of 6 years (Department of Pharmaceuticals, 2020b). A Scheme for Promotion of Bulk Drug Parks has also been introduced under which three bulk drugs parks are proposed to be set up. These parks will have common facilities such as solvent recovery plant, distillation plant, power & steam units, common effluent treatment plant etc.

3.5. Export potential- Focus on Personal Protective Equipment

Given the changing dynamics due to COVID-19, the current scenario created demand for several medical goods. In particular, there has been a surge in the usage of personal protective equipment (PPE), including masks, body coveralls, and face

Chart 5a: Imports of Bulk Drugs and Drug Intermediates

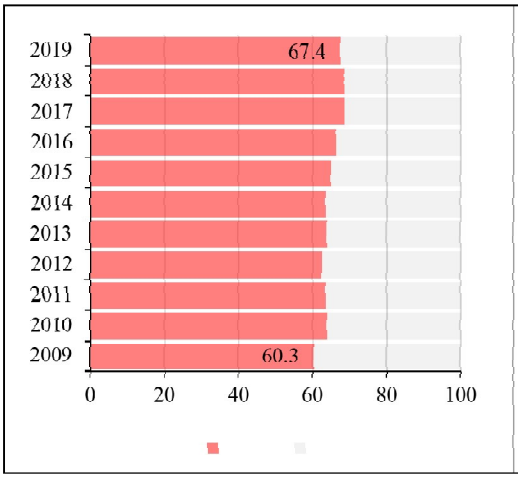
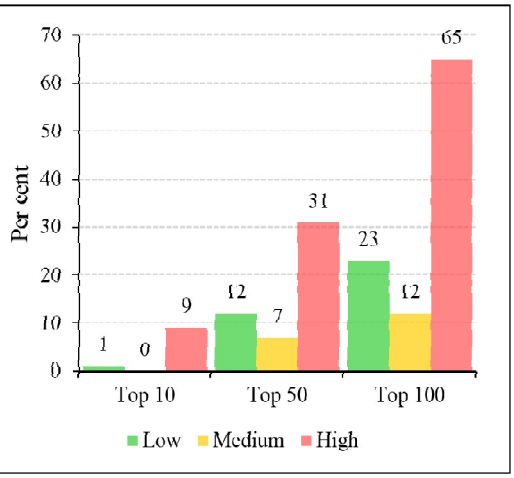


Chart 5b: Dependency on China in Bulk Drug Imports

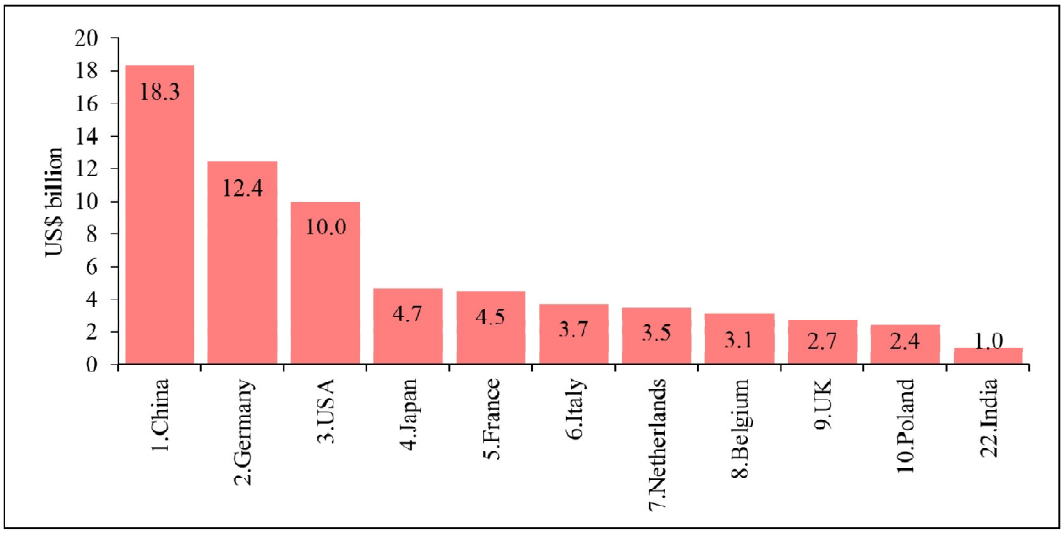


Source: Authors' calculations based on DGCI&S.

shields, gloves etc, in an attempt to limit its spread. Trade-in PPE came into the spotlight, especially as countries struggled to ensure enough supplies for their citizens and healthcare system. The initial wave of COVID-19 cases highlighted the concentration risks in manufacturing and trade in PPEs, with China being the lead exporter of PPE products, accounting for 18.3 of global exports in 2019 (Chart 6).

Further, China accounted for close to 60 per cent share of total exports of fabric type face masks, nearly 25 per cent of the total exports of plastic face shields and 10 per cent in case of sanitisers in 2019. India too had been highly dependent on imports of China, especially in case of certain PPE products like medical goggles, face masks and protective garments. The demand for textile face masks increased by nearly six times in 2020:H1 to more than US$ 30 billion from nearly US$ 6 billion during the corresponding period in 2019 as textile face masks emerged as the single most important product in the fight against COVID-19 (Chart 7). The dependence on China got further aggravated as China accounted for nearly 90 per cent of the imports of textile masks in 2020:H1. For almost all major importers of face masks including India, the dependence on China for textile face masks shot up sharply in 2020:H1. However, to meet the challenge posed by COVID-19, there has been a ramp-up in domestic production of PPE products in recent months. In the case of body coveralls, more than 1000 manufacturing firms have obtained the necessary license and certification for its production and are estimated to be producing nearly

Chart 6: Country-wise Ranking of Exports of PPE



Sources: Authors' calculations based on UN COMTRADE and WTO.

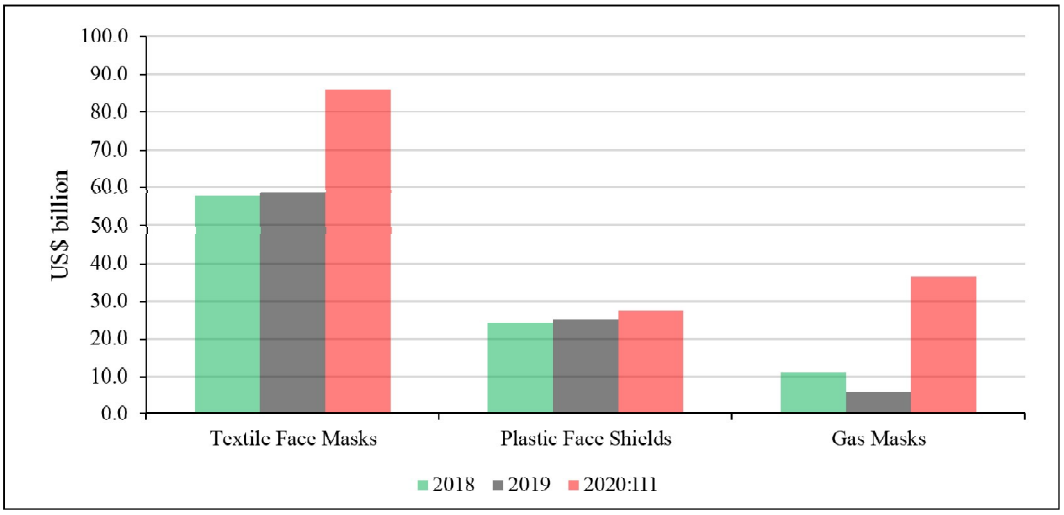
4.5 lakh units per day. Thus, today India has become the 2nd largest producer globally, producing nearly 1 billion USD worth of body coveralls. This allowed India to become an import-dependent country to an export surplus country. Consequently, the export restrictions on PPE products have gradually been relaxed.

With the emergence of newer strains of COVID-19 in different parts and challenges to a global immunisation drive in the form of efficacy against newer variants, vaccine supply constraints and logistical constraints for delivery of vaccines; there is growing acceptance of PPE products being a part of the new normal. This is expected to support the robust external demand of PPE products going forward along the similar lines as seen in 2020, at least till the pandemic lasts (Table 1).

3.6. Export potential - Medical Devices

Another category of crucial goods which saw an increase in global demand relates to medical devices. Medical devices play a role not only in screening, diagnosing, and treating patients but also in restoring patients to normal lives and in regularly monitoring health indicators to prevent diseases (Deloitte & NATHEALTH, 2016). India is among the top 20 global markets for medical devices and further, the market is expected to grow rapidly, especially given the focus post COVID-19, from nearly US$ 11 billion in 2020 to almost US$ 50 billion in 2025. Further, the increased push

Chart 7: Import dependency on China for Face Masks and face shields



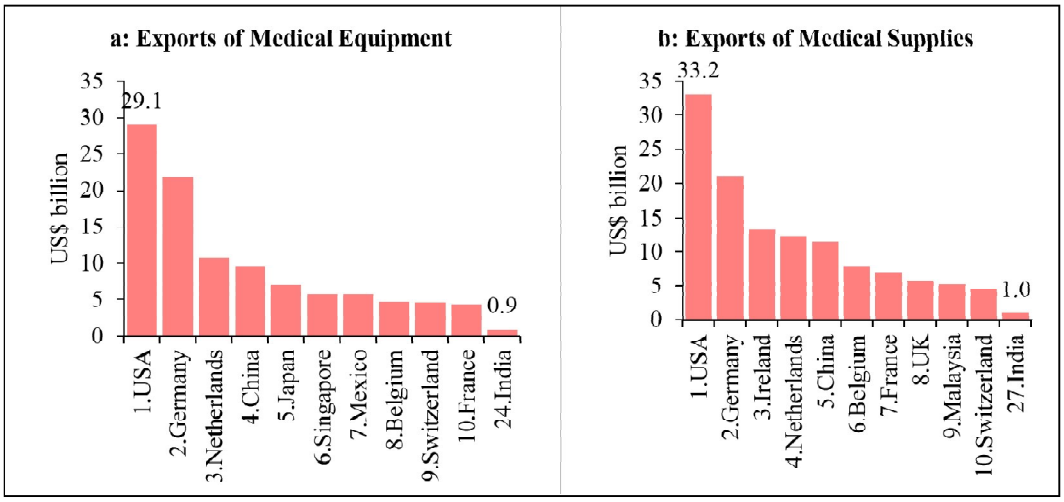
Source: Authors calculations based on WTO.

towards healthcare is expected to increase the expenditure on medical devices, as currently, India has the lowest per capita expenditure at around US$ 3 on medical devices among BRIC countries compared to China (US$ 7), Russia (US$ 42) and Brazil (US$ 21) (India Brand Equity Foundation, n.d.).

However, presently India's lacks domestic production manufacturing capacity which may be attributed to lack of adequate infrastructure, domestic supply chain and logistics; inadequate availability of quality power; limited design capabilities and low focus on R&D and skill development (Department of Pharmaceuticals, 2020c). This has adversely impacted India's export performance, with India ranking 24th globally in exports of medical equipment (Chart 8a).

The leading exporters of medical equipment as expected are developed economies that house the leading medical giants who invest heavily in R&D and have access to capital required for this industry. Even in the case of medical supplies, which are low-value items and less capital intensive, India has failed to establish itself among the top exporters globally and is ranked 27th globally (Chart 8b). It has also made the domestic medical devices market in India to be heavily dependent on imports (with imports accounting for nearly 85 per cent share of the domestic market) (Department of Pharmaceuticals, 2020a). Domestic manufacturing is limited to surgical, cardiac stents and general medical devices and consumables (Mahal & Karan, 2009). The medical device industry is highly capital intensive, has a long gestation

Chart 8: Exports of Medical Devices



Sources: UN Comtrade, WTO, and Authors' Calculations

period, requires a well-developed eco-system & innovation cycle and investment in research & development to enable continuous induction of new technologies.

To boost domestic production and to harness the export potential in the medical devices industry, a scheme for the Promotion of Medical Device Parks has been introduced. These parks will provide common testing and laboratory facilities at one place, reducing the manufacturing cost significantly and will help in creating a robust ecosystem for medical device manufacturing in the country. A PLI Scheme for Promoting Domestic Manufacturing of Medical Devices has also been introduced, which will provide a financial incentive to selected companies at the rate of 5 per cent of incremental sales of goods manufactured in India for a period of five years, *i.e.* from 2021-22 to 2025-26 (Department of Pharmaceuticals, 2020c).

4. Empirical Analysis

As discussed in the previous section, Indian pharma sector exports have grown at a rapid pace in recent decades on the back of Indian pharma firms' enormous success in establishing themselves in developing economies as reliable and cost-effective providers of medicines. However, unable to penetrate in developed economies, ascertains closer analysis. Given this background, the section examines the determinants which affect a firm's export intensity. Analogously, a firm may expect an improvement in its exports through an upgradation in various factors. To compete

with foreign firms and increase its exports, a firm requires competitive advantage. More specifically, the paper estimates the performance of firms' exports in period 't' as a function of a number of firm-specific characteristics. Existing literature and above analysis indicates that firm-specific determinants such as R&D expenditure, raw material imports, capital intensity, imports of intermediates etc., play a critical role in examining the extent of export intensity of a firm (Aggarwal, A. 2006; Girma *et.al* 2008; Grazzi, M et.al 2017; Rentala *et.al* 2017). This paper examines firm's export intensity and its relationship with crucial firm specific factors such as R&D, imports, capital expenditure.

To ascertain the supply side factors influencing India's pharmaceutical export performance, we have used the Prowess database of the Centre for Monitoring Indian Economy (CMIE). The database contains data for more than 300 pharmaceutical companies for the time period 2010-2020. However, the sample has been restricted to 67 pharmaceutical firms that have positive exports to sales ratio during the sample period. Pharmaceutical firms' data reflects a continuous upward trend in exports to sales ratio, which supports our analysis that India's exports in drug and pharmaceutical sector pulled the overall growth of country's exports up. The hypothesis of the paper relates to the examination of the influence of firm-specific factors for 67 pharmaceutical firms on their exports intensity, employing panel regression model. Following Grazzi, M *et al.* 2017 and Rentala *et al.* 2017 the paper uses a panel estimation specification which is outlined below:

$$V_{it} = \alpha_0 + \alpha_i X_{it} + T_t + T_i + \varepsilon_{it}$$

Where the dependent variable (V) is exports by firm 'i' as a proportion of its sales in the 't' year or in other words, export intensity of the firm. X represents a vector of firm-specific explanatory variables viz., imports of raw materials to overall purchase of raw material of a firm (imports intensity); R&D expenditure to sales ratio (R&D intensity); total debt as a percentage of total assets (leverage ratio); net fixed assets as a percentage of total sales (capital intensity); and profits after tax as a ratio of sales (profitability). T_t and T_i are time fixed effects and firm fixed effects to control for conditions in different financial years and in different firms, respectively. In order to determine whether a fixed or random effect panel model is applicable, we have used the Hausman speciation test. The result indicated in Table 2 shows that the null hypothesis is rejected, and a fixed effects model may be used[8]. We choose a fixed effect model over random effect in order to overcome any omitted variables bias and as some of the observed variables could be correlated with unobserved.

Table 2: Results of Hausman Test with exports (Test Summary)

Variable	*Value*
Chi2 (5)	33.47
Prob>chi2	0.0002

Note: Ho: difference in coefficients not systematic.

Decomposition of firms' export intensity reveals that higher R&D, capital intensity and profit after tax, plays a fundamental role in strengthening exports earnings. Literature also indicates that innovative domestic firms, which leverage highly intensive technology and produces differentiated goods, tend to perform better in exports (Grossman 1995; Bleaney 2002). In other words, higher R&D expenditure helps a firm improves its products and operations and thereby remain competitive in foreign markets (Grossman and Helpman, 1991a). Investment in R&D not only strengthen innovations, but also help firms to enhance the assimilation of external technological knowledge.

Table 3: Determinants of Export Intensity- Empirical Results

Variables	*Model (1)*	*Model (2)*	*Model (3)*
Profit after tax	.068*	0.047*	0.03***
	(2.87)	(1.7)	(1.68)
Research and Development	0.69*	.59*	.83*
	(3.97)	(2.71)	(3.6)
Capital Intensity	.03*	.025**	.017
	(3.38)	(2.16)	(1.6)
Leverage	-.023	.03	.04
	(1.2)	(0.99)	(0.87)
Raw material Imports	.10*	0.16*	.24*
	(2.93)	(3.33)	(3.72)
No. of Company	67	35	20
Time Fixed Effects	Yes	Yes	Yes
Company Fixed Effects	Yes	Yes	Yes
R-squared	.86	.74	0.72

Note: Analysis is based on financial year data. Values in parentheses represent t-statistics. Coefficients with *, ** and *** reflect significance at 1, 5 and 10 per cent, respectively. The dependent variable is the export intensity. Columns (2) and (3) additionally examine the analysis for companies where exports are greater than last 5 years overall average and top 20 companies.

Source: Authors' calculations.

Table 3- Regression Model 3 assesses the importance of R&D expenditure for top firms' export intensity. The coefficient shows that a larger proportion of R&D would result in greater export intensity for top firms. This positive relationship can be interpreted as the role of innovation in supporting firms export intensity. However, in the case of India, pharmaceutical companies spend only around 8-13 per cent of their turnover on R&D currently[9]. As compared to other industries the R&D expenditure by Indian Pharmaceutical companies is high but when compared globally it's still low (Aggarwal 2006). As highlighted earlier, one of the reason behind low expenditure on R&D by Indian firms relates to the fact that India's pharmaceutical companies which are primarily involved in generics medicine production may not requires huge investment in R&D (Joseph 2012). As mentioned above, with the growing change in pattern, pharmaceutical firms have shifted their focus from low-value bulk drugs and intermediates to relatively higher value formulation exports in a bid to capture a larger share of value addition (Akhtar, 2013; Joseph, 2009). Given the shift in the drug and pharmaceutical policies and the focus on the development of new products, Indian firms may need to strengthen their R&D base. Also, higher R&D expenditure by Indian firms would allow India to better cater to the demand of major pharma importers, mostly developed countries.

On the other hand, import intensity also positively impacts the export intensity, possibly due to a high reliance on raw material imports by India's pharmaceutical sector. This is evident in the case of India's bulk drugs and intermediates imports, which are crucial for formulation preparations. The coefficient of import intensity is much stronger for high export intensive firms (Table 3- regression 2 and 3). The table also shows a positive relation between profit after tax and export intensity and significant. Fryges and Wagner (2008) research find a positive profitability difference between exporting and non-exporting German firms. Roberts *et al.* (1997) document that mostly productive firms finds it profitable to operate in the export market and incur a sunk cost. Firms earning large profits could face larger competition in exporting market. Melitz (2003) notes that firms which produce above the export productivity cut-off are able to export. Srinivasan and Archana (2011) found a positive and significant relationship between profitability and exports.

Another important variable in the regression is capital intensity. The global pharmaceutical industry is a highly capital-intensive industry due to massive capital outlays on R&D[10]. According to a report by Mckinsey, "given the capital-intensive nature of pharma R&D, firms require a stable backbone of technical competencies

in any R&D operating model"[11]. The empirical evidence above reflects a positive relationship between pharmaceutical exports and capital intensity. Kumar and Siddharthan (1993) argue that in case of high technology industries, such as pharma, higher degree of capital intensity provides a competitive advantage in exports. Ganguli (2007); Rentala *et.al* (2014) also noted that capital intensity has a significant and positive impact on Indian export performance.

Table 3 also shows a negative relation between leverage ratio and a firm's ability to export. Myers and Majluf (1984) notes that leverage may be seen as debt after firm's internal funds are exhausted. According to this theory, leverage may provide some degree of firm' state of financial condition. A probable reason behind the negative relationship could be that firms with higher leverage ratios have low liquidity, leaving them with little capital to finance sunk costs required to enter the exports market (Kim H., 2016 and Greenaway D., *et.al.*, 2007). The results derived from our analysis are in line with the finding of previous studies, which notes that lower leveraged firms have a greater likeliness to export goods (for example Kim 2016).

5. Conclusion

COVID-19 pandemic has disrupted the supply chains for global pharmaceutical companies; however, it also provided an opportunity for countries like India to expand their share in global drugs & pharmaceutical exports by leveraging its existing strengths. Pandemic has also offered an opportunity to focus on other products in medical goods, namely medical devices, personal protective products and vaccines, which have gained high relevance to fight the COVID-19 pandemic. Empirical analysis reveals that R&D, import intensity and profitability plays a crucial role in strengthening firms' export performance. Importantly the analysis reflects that a greater proportion of investment in innovation in the form of R&D helps in improving product quality and enhances competitiveness. Thus, there is a need to incentivise R&D expenditure. Firm-wise analysis also reveals that the coefficient of import intensity is much stronger for high export intensive firms, reflecting the higher dependence on raw material imports. This is evident in the case of India's bulk drugs and intermediates imports, which are crucial for formulation preparations. These findings are important from a policy perspective, government has already taken several initiatives to reduce import dependency in certain key drug intermediates and APIs by introducing the PLI scheme. However, finding an alternative supplier is a long-term process and may take time to yield desired results.

Notes

1. Dhirendra Gajbhiye is a Director, while Sonam Choudhry and Shobhit Goel are Managers in Department of Economic and Policy Research (DEPR), Reserve Bank of India (RBI). The views expressed in the paper are those of the authors and not necessarily those of the institution to which they belong.
2. Sun Pharma was established in 1983 and Dr. Reddy's Lab in 1984
3. Sun Pharma was established in 1983 and Dr. Reddy's Lab in 1984
4. *https://www.outsource2india.com/kpo/samples/pharmaceutical-industry-report.asp#:~:text=Pharmaceutical%20Industry%20Report-,A%20Global%20Pharmaceutical%20Industry%20Report,owned%20and%20is%20technologically%20sophisticated.*
5. *https://www.mckinsey.com/industries/pharmaceuticals-and-medical-products/our-insights/r-and-d-in-the-age-of-agile*
6. According to FDA, a generic drug is a medication created to be the same as an already marketed brand-name/ earlier patented drug in dosage form, safety, strength, route of administration, quality, performance characteristics, and intended use. These similarities help to demonstrate bioequivalence, which means that a generic medicine works in the same way and provides the same clinical benefit as the brand-name medicine.
7. Statistica.
8. For robustness we used Breusch-Pagan Lagrange Multiplier for testing random effect which provides the same conclusion.
9. IBEF – report on Pharmaceutical November 2020
10. *https://www.outsource2india.com/kpo/samples/pharmaceutical-industry-report.asp#:~:text=Pharmaceutical%20Industry%20Report-,A%20Global%20Pharmaceutical%20 Industry%20Report,owned%20and%20is%20technologically%20sophisticated.*
11. *https://www.mckinsey.com/industries/pharmaceuticals-and-medical-products/our-insights/r-and-d-in-the-age-of-agile*
12. *https://www.ibef.org/download/Pharmaceuticals-January-2021.pdf*

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