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Bilateral Trade Potential of IP Sensitive Products: A Comparative Study of India and China

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Abstract This study examines performances and varieties of export of IP sensitive products across emerging countries, namely, India and China by utilizing 6-digit disaggregated product-level export data. Further, this study constructs trade margins — extensive and intensive margins to understand trade potential and different trade patterns, specifically, exporters' productivity, product diversification, and volume of trade during 2007-2016. This study finds India's performance is comparable with China at the extensive margin though the gap between India and China is very wide in terms of the total value of exports and the intensive margin. China majorly exports more expensive electronics and manufacturing-related products as opposed to relatively cheaper medicinal and synthetic products, the total value of exports from China to the rest of the world is much higher than that of India. This study suggests that India is exporting IP-sensitive products to lower-income countries sufficiently, but the IP-sensitive exports to higher-income countries are still lagging.

Keywords Exports, IP-sensitive products, Trade margins, Product-level data, Technological innovation

I. Introduction

One of the main objectives of "Agreement on Trade Related Aspects of Intellectual Property Rights" (TRIPs) under the aegis of World Trade Organization (WTO), according to its article 7 is, "…the promotion of

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technological innovation….". Many developing countries made legislative changes to comply with the agreement including India and China. The question if such policy changes lead to more innovations in developing countries has been addressed in the theoretical and empirical literature (Kanwar and Evenson, 2003; Chen and Puttitanun, 2005; Kim et al., 2012). The empirical evidence underscores that there is no straightforward answer as the net impact of patent protection on innovation is conditioned by different factors. The studies show that the influence of patents on innovation rather varies considerably across sectors (Allred and Park, 2007; Sharma et al., 2018). Such innovation capabilities are expected to be translated into the country's export competitiveness (Panda and Sharma, 2020). However, it remains unexplored if such patent policy changes have increased the exporting capabilities of the developing countries, particularly in the field of patent-sensitive industries. Panda et al. (2020) also show that patent rights influence the technological efforts and exports of the source country. This study links the patent rights index and innovation activities and exports at the aggregate level. Building on this literature, we base the analysis in the current paper at disaggregate product-level data at the 6-digit level. This motivates the current exploratory research on the trade potential, patterns, and classifications across emerging countries, namely, India and China.

The technological activity of countries determines the resources devoted to creating new products and/or new processes to reduce the costs. Many times such efforts lead to patents that provide firms with a strong competitive edge in the international market. We argue in this study that existing studies do not capture the bilateral trade potential of IP-sensitive products across emerging countries. We extend the existing literature by capturing the increase in the variety and volume of exports of India and China. To support how emerging countries' exports are spread, we analyze extensive and intensive margins of trade of India and China during 2007-16 by utilizing 6-digit disaggregated products level exports data. The extensive margin is based on the change in the number of trading partners or number of products traded, whereas the intensive margin refers to the change in volume of trade among two countries. The very idea for considering such two margins is based on heterogeneous firm trade models as Chaney (2008) shows that trade policy changes affect the number of trading partners or the number of products traded (i.e., extensive margin) and change in volume of trade among two countries (i.e., intensive margin) as well. From a policy perspective, the changes in the extensive and intensive export margins have different growth and welfare implications. The performance of trade margins in developing countries is also different among product groups (Veeramani et al., 2018). Hence, we are interested to understand the patterns of bilateral trade and the product dimension for India and China at the disaggregated level in IP-sensitive product categories.

Based on the extent of coverage (allowing patents in various fields), membership in the international patent agreements, enforcement mechanisms and duration of protection, Ginarte and Park (1997) and Park (2008) highlight that patent protection in India and China has strengthened after TRIPs related changes. In Table 1, the index value of patent rights in India during 1970-2005 is given. In 1960, the value of the index was 1.85 which decreased to 1.42 in 1970. During 1970-2000, there is a continuous decrease in the value of index. This is due to the introduction of the Patent Act 1970. According to the Patent Act 1970, only process innovations can be patented in the fields of food and medicine for the duration of 7 years, whereas in other fields of technology, the duration was 14 years. In 2000, the value of index was 2.27 which was 84.55% higher than 1995. This value further increased to 3.76 in 2005. Moreover, the index has also increased from 1.33 to 4.08 in the Chinese case.

Table 1 Index of Patent Rights

Year	India	China
1960	1.85	NA
1965	1.85	NA
1970	1.42	NA
1995	1.62	NA
1980	1.62	NA
1985	1.62	1.33
1990	1.48	1.33
1995	1.23	2.12
2000	2.27	3.09
2005	3.76	4.08

Source: Adopted from Ginarte and Park (1997) and Park (2008)

We find India has been evolving in its exports of IP-sensitive products with extensive investment in research and development, innovation, design, and knowledge in the technological sector, albeit at a slower pace than China. India is exporting high technology products to lower-income countries sufficiently, but the high technology exports to higher-income countries are still lagging. The ratio of average extensive margins and average intensive margins of China and India stays almost constant from 2009 to 2016 in both Global North and Global South. However, India still lags far behind China in Global North nations at an average intensive margin level.

Our paper contributes to the existing literature by examining the bilateral trade potential of IP-sensitive products across emerging countries, namely, India and China. Second, this study utilizes 6-digit disaggregated product-level export

data to decompose trade classification such as extensive and intensive margins of trade. Third, this study captures the increase in the variety of exports and shows the changes in tastes of the importer and how emerging countries' exports are spread across varieties. Lastly, this study highlights the patterns of bilateral trade and the product dimension for India and China and finds India is exporting high technology products to lower-income countries sufficiently, but the high technology exports to higher-income countries are still lagging.

The rest of the paper is organized as follows. Section 2 sets the background by reviewing the existing evidence. Data are presented in Section 3. Section 4presents the comparative analysis of the bilateral trade potential of India and China. Summarizes and concludes the paper in Section 5.

II. Literature Survey

The neo-technology models[1] argued for the limited role of technology in explaining developing countries' export behavior. Recent studies argue that emerging economies of Asia now engage with new technologies and are active partners in international commerce (Panda and Sharma, 2020). Clearly, there is an advancement in their technological stature in the international market from being a mere adapter of existing technologies to being innovators of the frontier technologies. Panda and Sharma (2020), accordingly, question the prevalent existing viewpoint of categorizing developing countries as mere technological followers.

There has been a significant change in world trade as the share of emerging economies increased in manufacturing exports (Tewari and Veeramani, 2016). It is very important for every economy to boost the industrial output for which innovative technologies and products are required. By exporting, firms exploit idle operating capacity, develop production efficiency, and improve technological quality and service standard that raises their profits and returns to investment. Furthermore, such activities generate funds for future investment and growth (Guan and Ma, 2003). Studies argue that export performance is enhanced when countries, specifically developing economies, are able to move beyond trade in primary and low technology goods to high-technology products (Lall, 2000; Srholec, 2007).

With the aim of understanding different trade patterns, existing literature analyses the importance of extensive and intensive margins of international trade. Owing to the extensive margin, there is a variation in trade across trading

1 See Dasgupta and Siddharthan (1985), Kumar (1990), Kumar and Siddharthan (1994), and Willmore (1992).

partners, while a change in the value of trade across one-year intervals is due to the intensive margins (Bernard et al., 2009). Notably, Melitz (2003), Helpman et al. (2008) and Chaney (2008) explicitly develop trade models that reflect the decision to export, particularly the extensive margin of trade. Various studies highlight that the intensive margin of trade significantly contributes toward the long-run export growth. Krugman (1980) envisages that all export variations happen only on the intensive margin of trade because all firms are interested in exporting to destination countries. As the new exporting basket can improve the use of resources and allocate efficiency in the economy, Feenstra and Kee (2008) suggest that increase in sectoral export variety boost country productivity. Interestingly, Fernandes et al. (2016) suggest that most exporters are based in developed economies. In these economies, the expansion of international trade occurs through both extensive and intensive margins as the firms are large with access to better resources. The study also establishes that this result of large firms from developed economies having a high share of trade is consistent with the standard model of trade with heterogeneous firms. Exports can differ across trading partners along with extensive and intensive margins of trade. A question arises about how these trade margins are important across emerging countries' IP-sensitive products.

The role of technology in international trade is emphasized in technology-based models, such as the technology-gap theory of trade (Posner, 1961) and the life-cycle approach to trade (Vernon, 1966). Such models suggest that technology is an important component of the international competitiveness of the countries. To become internationally competitive, developing countries undertake extensive technological activities, which are likely to contribute towards export performance and economic growth. To comply with TRIPs, developing countries changed their IPRs legislations. Such changes boost the investments made in R&D that strengthen the economies' international competitiveness (Cooper, 1991; Gold, 1982)

Guan and Ma (2003) find that innovation capability dimensions are important in determining Chinese firms' export performances. Moreover, Bhat and Narayan (2009) argue that the achievement of technological capabilities (in-house R&D) is significant in determining the export performances of the Indian chemical industry. Chadha (2009) finds that foreign patent rights (technology proxy) have a positive impact on Indian generic pharmaceuticals exports by considering the later stage of product cycle development. She also suggests that developing countries have the potential to establish in the international market through innovation skills (by using patents). Considering the role of export mode, Dai et al. (2020) find an inverted-U relationship between innovation intensity and firms' export survival by using panel data from China during 2000-2010. Besedeš and Prusa (2011) argue that for long-run export growth, the survival of trading relationships is important. Thus, to improve export growth, developing

countries focus on the existing relationships. Veeramani et al. (2018) perform a comparative analysis of trade margins in emerging countries namely India and China. They suggest that India's exports are lagging China's exports along with the intensive margin. Within all product sectors, they find that there is a huge gap between India-China export performance in quantity margin. Mostly, India's export growth is in favor of human capital- and technology-intensive products; however, India does not concentrate on unskilled labor-intensive products and network products groups. They also argue that China's exporting is biased towards high-income partner countries by specializing in labor-intensive products. Building on that work, we further investigate the extensive and intensive margins of trade for the patent-sensitive products.

III. Data

In this study, we are interested in exports data at the product level and further use it to construct the margins — extensive and intensive margins during 2007-2016[2]. We started our research in 2007 as by that time, most patent policy changes were completed in both nations. Export data are extracted at the Harmonised System (HS) 6-digit level of disaggregation from UN COMTRADE. We use different concordance tables[3] to convert all the data to HS-0 classification, as the Harmonised System (HS) classification has changed over time. Following Delgado et al. (2013) classification, we take patent-sensitive products that are classified in the Standard International Trade Classification (SITC), and then, we made concordance between SITC and HS (see Annexure I).

To build the margins of exports, studies apply the count methodology that decomposes total exports into extensive and intensive margins (Bernard et al., 2007; Dutt et al., 2013).[4] In a log-linear form, the decomposition of total exports (EXP) can be expressed as follows:

2 The reason for taking this period is due to the compliance with TRIPs by developing countries by 2005.

3 Available at https://wits.worldbank.org/product_concordance.html

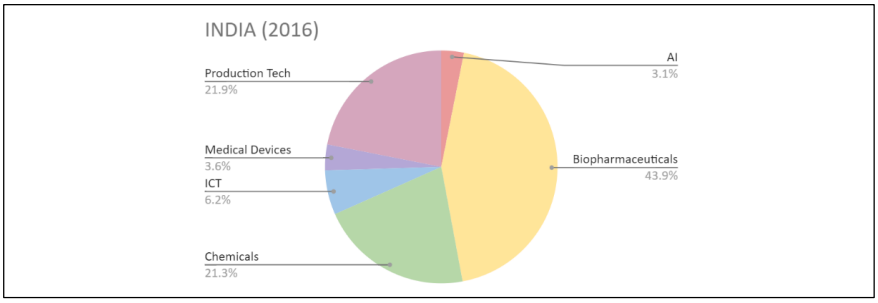
4There is also an alternative method to construct the margins, developed by Hummels and Klenow (2005). They define the extensive margins (a wider set of goods) as a weighted count of the product groups that a country exports relative to the product groups exported by the rest of the world, and they define the intensive margins as countries export larger quantities of each good. Dutt et al. (2013) compares the count method and the Hummels and Klenow (2005) method of extensive and intensive margins, they find that the correlation between the count and the Hummels and Klenow (2005) method is around 0.86 % of the extensive margins and is around 0.88% of the intensive margins.

$$lnEXP_{ij,t} = \ ln(N_{ij,t}) + ln\left(\frac{EXP_{ij,t}}{N_{ij,t}}\right) \qquad (1)$$

where $EXP_{ij,t}$, the real total bilateral exports (sum of total exports for all products for a given year). Total exports between a country pair are decomposed into two different variables, namely, the extensive margin of exports as a count of the number of HS-0 products that were exported from *i* to *j* in period *t*, i.e., $N_{ij,t}$, and the intensive margins as a simple average value of exports per product, i.e., $EXP_{ij,t}/N_{ij,t}$. The extensive margins of trade can account for a large share of the variation in imports and exports across countries.

IV. A Comparative Analysis: India and China

Exports in the IP-sensitive products, biopharmaceuticals, chemicals, information and communication technology (ICT), medical devices, and production technology[5] indicate a country's economy, level of productivity and potential capabilities. Being a leading provider of software exports and pharmaceuticals, India has been evolving in its exports of patent-sensitive products with extensive investment in research and development, innovation, design, and knowledge in the technological sector, albeit at a slower pace than China. Following pie-charts show that the exports in 2016 in China are largely driven by ICT (64.1%), followed by Production Technology (20.8%), while those in India are dominated by Biopharmaceuticals (43.9%), followed by Production Technology (21.9%) and Chemicals (21.3%). A similar trend was followed throughout 2009-2015 for both the countries (see Figures 1, 2, and 3).



5 Note that most of these product categories overlap with high-technology category as identified by OECD except the aerospace sector. We use the IP-sensitive products in line with the key objective of the paper.

Figure 1 India's IP Sensitive Products

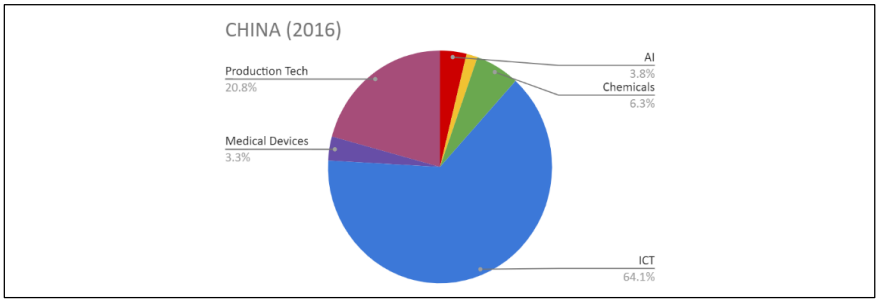


Figure 2 China's IP Sensitive Products

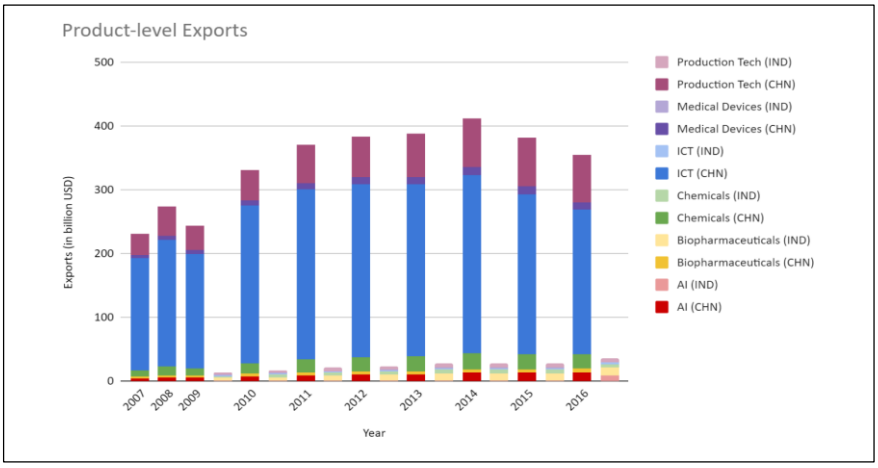


Figure 3 Product-level Exports of India and China

The export potential of a country can be further explored by distinguishing between extensive as well as intensive margins. As discussed earlier, extensive margin refers to creating new trade relationships, while intensive margin refers to improving the existing trade relationships. While the intensive margin-based growth focuses on changing the exports of already exported products to already existing partners in terms of price or quantity, the extensive margin-based growth focuses on diversification in terms of either newly exported products or new export partners. In this section, we compare India's export performance in terms of the total value of exports, intensive margin, and extensive margin with China. Table 2 shows that China outperforms India. While India's performance

is comparable at the extensive margin, the gap between India and China is very wide in terms of the total value of exports and the intensive margin.

Further, we analyze the IP-sensitive exports of India and China across their partner countries. At the partner level, we further compare the aggregate high technology exports based on income type, development type, and region type.

Table 2 Volume of Total Exports, Extensive Margin and Intensive Margin

Countries		2009	2010	2011	2012	2013	2014	2015	2016
Exports	India	385000	504000	576000	627000	678000	700000	692000	648000
	China	19100	20700	27700	29500	33900	31300	31000	31900
Extensive Margin	India	55.45	57.84	59.32	61.16	62.58	65.11	65.71	66.51
	China	32.60	33.31	35.90	37.26	38.13	39.36	39.24	40.22
Intensive margin	India	729.54	920.97	1047.04	1141.49	1219.26	1252.34	1225.95	1143.56
	China	63.02	67.46	81.37	102.35	95.26	86.25	84.84	86.18

Note: All values are in millions of USD

1. Partners at the Income Level

We split the partners of India and China based on their income level with 31 low-income, 41 lower-middle-income, 59 upper-middle-income and 72 high-income partners. Table 3 shows the average exports to each income category by India and China from 2009 to 2016. While average exports to low-income partners are comparable in both India and China, with China in the lead, the gap keeps widening as we move to lower-middle, upper-middle, and high income. The average exports from China increase by a hundredfold as we move towards higher income partners, however, the same is not the case with India. The average exports to high-income countries are only four to five times the exports to low-income countries by India. This shows that India is exporting high technology products to lower-income countries sufficiently, but the high technology exports to higher-income countries are still lagging.

Table 3 Exports of India and China across different Income Groups

Income-Type		2009	2010	2011	2012	2013	2014	2015	2016
China	Low	69.54	76.31	73.12	79.50	73.80	106.36	115.79	114.41
	Lower-middle	711.64	855.96	1,011.23	1,063.98	1,216.67	1,388.66	1,451.40	1,517.02
	Upper-middle	618.17	834.69	1,012.52	1,094.35	1,194.05	1,277.44	1,208.84	1,169.39
	High	4,261.38	5,621.61	6,365.93	6,933.00	7,447.59	7,556.46	7,474.63	6,870.03

India	Low	30.59	34.51	45.58	48.44	58.47	61.21	58.04	64.08
	Lower-middle	78.67	69.37	97.45	108.32	122.43	121.23	117.74	121.03
	Upper-middle	74.90	75.13	104.64	110.80	132.32	113.81	105.53	106.33
	High	141.83	167.72	219.01	234.30	261.39	243.15	248.62	256.32

Note: All values are in millions of USD

This is also evident from the ratio of the average extensive and intensive margins of China vis-à-vis India from 2009 to 2016. We find that India's exports are satisfactory for low-income, less developed, and less technologically advanced countries in comparison to China. However, for more affluent, developed, and higher R&D and innovation countries, India fares much worse than China. The extensive margin ratio of China and India lies between 1 and 2 for all income groups implying new partner and new product relationships are being established at almost the same pace. The intensive margin ratio for China and India rises starkly from around 1 for low-income countries to ranging between 15-25 for high-income countries (see Figures 4 & 5).

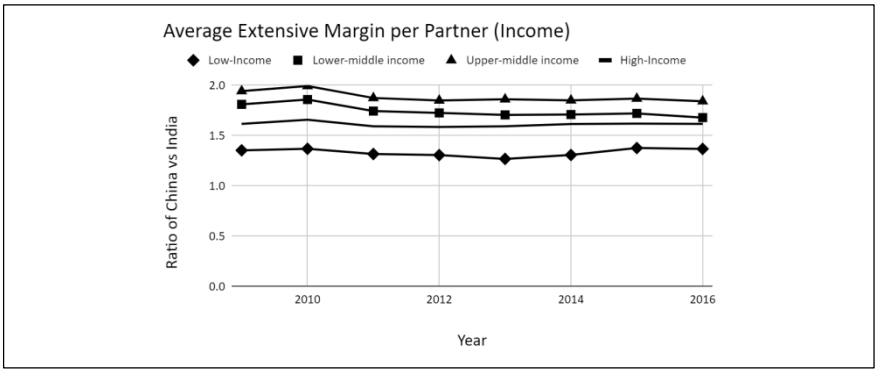


Figure 4 Income-wise Average Extensive Margin

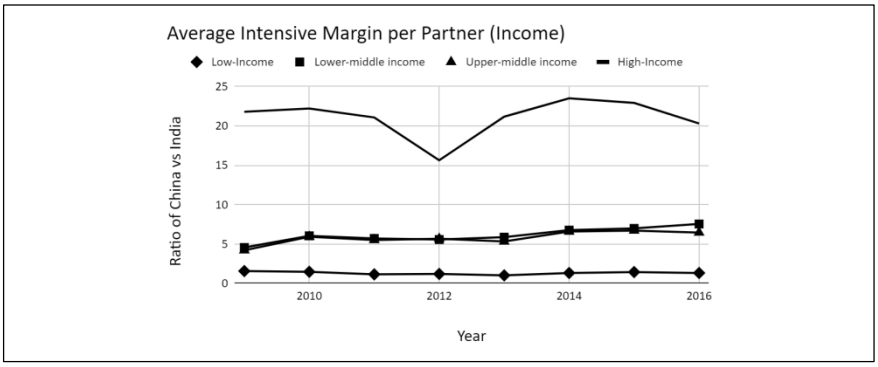


Figure 5 Income-wise Average Intensive Margin

2. Partners at the Region Level

We split the partners of India and China based on their region level with 8 partners from South Asia, 54 from Europe and Central Asia, 19 from the Middle East and North Africa, 49 from East Asia and Pacific, 48 from Sub-Saharan Africa, 43 from Latin America and the Caribbean and 4 from North America. Table 4 shows the average exports to each region by India and China from 2009 to 2016. While average exports to partners belonging to less developed areas like the Middle East and North Africa, and Sub-Saharan Africa are comparable in both India and China, with China in the lead, the gap keeps widening as we move towards richer first world nations of North America and Europe and Central Asia. The difference is stark not only in the above-mentioned first-world regions but also in areas that share similar technological wavelengths with India and China, like East Asia and the Pacific as well as South Asia. This shows that India is exporting patent-sensitive products to less developed and less advanced countries at the expected level, but in countries with even similar levels of technological advancement, India lags far behind China. The difference gets even more evident with exports to developed countries, where India's exports are less than 1% compared to that of China.

Table 4 Exports of India and China across different Regions

Income-Type		2009	2010	2011	2012	2013	2014	2015	2016
China	East Asia and Pacific	3,489.73	4,519.15	5,252.35	6,197.09	7,111.99	6,973.66	7,167.18	6,523.51
	Europe and Central Asia	1,691.34	2,345.55	2,531.56	2,376.25	2,310.15	2,501.02	2,263.52	2,213.16
	Latin America and Carribean	334.82	474.78	615.22	641.28	699.83	707.85	660.84	599.58
	Middle East and North Africa	632.48	712.21	813.27	856.56	915.92	1,220.86	1,170.62	1,042.39
	North America	18,780.29	24,617.05	28,285.52	31,016.15	31,992.73	34,423.29	33,257.28	31,553.06
	South Asia	1,874.43	2,183.82	2,485.01	2,399.15	2,434.54	2,686.66	2,990.02	3,424.17
	Sub-Saharan Africa	99.95	129.47	144.52	152.63	172.11	195.66	206.84	186.20
India	East Asia and Pacific	84.52	76.17	100.90	106.10	121.49	113.68	108.37	114.32
	Europe and Central Asia	93.40	113.87	152.42	146.94	167.15	147.85	135.59	138.25
	Latin America and Carribean	18.97	24.40	34.03	43.49	44.53	43.58	43.00	40.42
	Middle East and North Africa	158.50	142.35	195.85	198.46	229.44	177.62	168.40	172.95
	North America	708.75	922.19	1,171.30	1,448.04	1,632.52	1,704.52	1,908.09	2,002.57
	South Asia	81.45	91.24	116.78	135.65	165.31	175.69	177.79	220.58
	Sub-Saharan Africa	49.63	51.89	72.49	78.85	93.42	87.82	86.30	81.96

Note: All values are in million USD

The following graphs show the ratio of average extensive and intensive margins of China vis-à-vis India from 2009 to 2016. The average extensive margin ratio of China and India lies between 1 and 3 for all the regions with maximum value for the Latin America and Carribean region. The average intensive margin ratio for China and India is almost the same for regions containing LDCs i.e., Sub-Saharan Africa and Middle East and North Africa. Also, the ratio falls sharply for North America from 2009 to 2016 implying a relatively strengthened export relationship between India and North America

region. The trend is opposite for the East Asia and Pacific region where the intensive margin of India has grown at a much slower pace than China (see Figure 6 & 7).

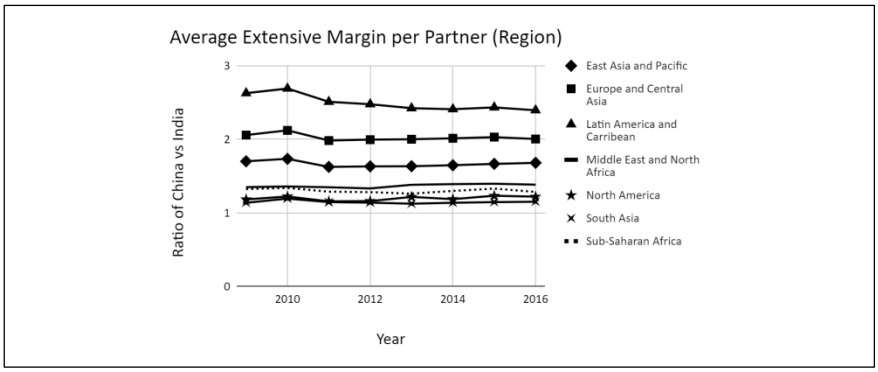


Figure 6 Region-wise Average Extensive Margin

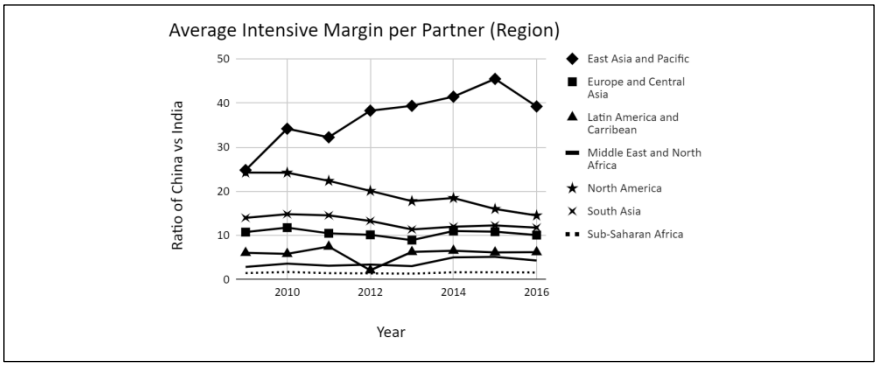


Figure 7 Region-wise Average Intensive Margin

3. Partners at the Development Level

We split the partners of India and China based on their development levels with 57 partners belonging to the Global North and 169 partners belonging to the Global South. Table 5 shows the average high-tech exports to each region by India and China from 2009 to 2016. The results are like the previous comparisons. There is a sharp increase in the high technology exports as we move from Global South to Global North in China, while the increase is quite humble in India. In the Global North, India's share in high technology products is only a hundredth of that of China.

Table 5 Exports of India and China across different Development Groups

Income-Type		2009	2010	2011	2012	2013	2014	2015	2016
China	North	5,364.68	7,118.73	8,065.22	8,778.48	9,430.34	9,551.32	9,403.73	8,717.90
	South	463.32	584.77	690.31	748.13	824.17	916.71	919.12	892.53
India	North	163.10	196.97	257.91	272.77	310.23	295.48	298.45	307.59
	South	57.07	55.42	75.92	82.70	94.58	85.51	82.46	84.87

Note: All values are in millions of USD

The ratio of average extensive margins and average intensive margins of China and India stays almost constant from 2009 to 2016 in both Global North and Global South. However, India still lags far behind China in Global North nations at an average intensive margin level (see Figures 8 & 9).

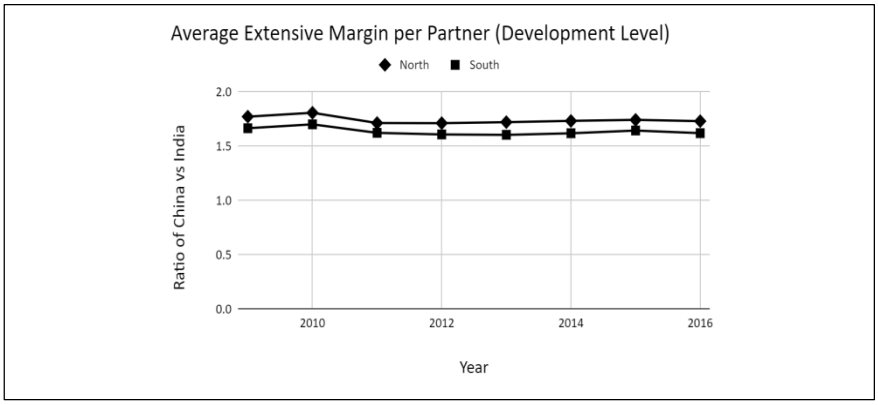


Figure 8 Development-wise Average Extensive Margin

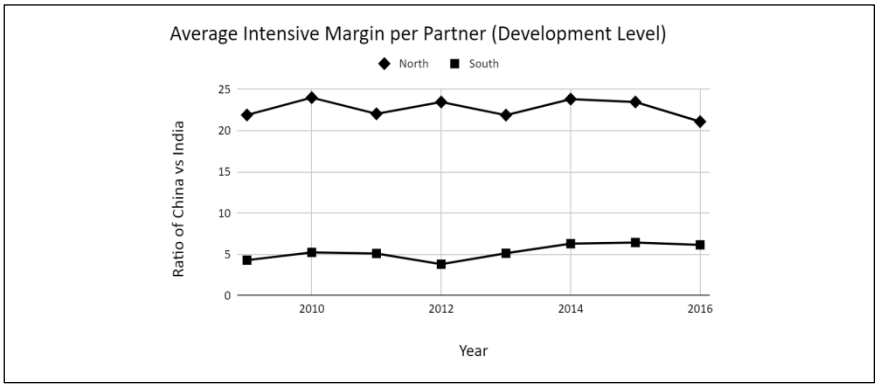


Figure 9 Development-wise Average Intensive Margin

V. Summary and Policy Implication

This study investigates the performances and varieties of export across emerging countries, namely, India and China. This study utilizes 6-digit disaggregated product-level export data and further uses it to construct the margins — extensive and intensive margins during 2007-2016.

The results show that India lags China in exporting IP-sensitive products to high-income countries. India's performance is comparable at the extensive margin. The gap between India and China is very wide in terms of the total value of exports and the intensive margin. China majorly exports more expensive electronics and manufacturing-related products as opposed to relatively cheaper medicinal and synthetic products, the total value of exports from China to the rest of the world is much higher than that of India.

Though we have not looked at the specific reasons for the lower exports. But based on our understanding, we suggest that to boost the exports along extensive and intensive margins, focused policy initiatives need to be designed. Under this, awareness programs for exporters about patent rights protection in other countries can go a long way in sensitizing the producers about such issues. Policymakers may also support exporters in the marketing of the products and brand creation through various schemes, including participation in international trade fairs. Initiatives to reduce the cost of exporters for patenting in different countries will also help exporters to increase the intensive margins.

India's current policies are aimed at boosting domestic production and promoting exports. The Merchandise Exports from India Scheme (MEIS) under the Foreign Trade Policy (FTP) 2015-20 promotes the exports of notified goods produced or manufactured in India. The Make in India Scheme of 2014 focuses on improving the manufacturing infrastructure of the country by fostering ease of doing business, facilitating investments, and nurturing skill development and innovation. The government of India also provides financial support and research grants to educational institutes for the active promotion of R&D. With these developments and reforms, India seems on the right track to boost technological innovation and high technology production.

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Annexure I

Table A1 High-IP Clusters (SITC Rev. 3 Codes)

harmaceuticals Medical Devices Medicinal & pharmaceutical products: 5411-6, 54199, 542	**Medical Devices** Diagnostic substances: 54192-3, 59867-9 Medical equipment & supplies: 59895, 6291, 774, 872, 8841
Analytical Instruments (AI) Optical instruments: 8714, 8744 Laboratory instruments: 87325, 8742-3 Process instruments: 8745-6, 8749	**Chemicals** Organic chemicals: 5124, 5137,5139, 5145-6, 5148, 5156 Chemically based ingredients: 5513, 5922, 5972, 59899 Dyeing & packaged chemicals: 531-2, 55421, 5977
ICT Office machines: 7511-2, 7519, 75991-5 Computers & peripherals: 752, 75997 Communications equipment: 7641, 76425, 7643, 76481, 7649, 77882-4 **Electrical & electronic components:** 5985, 7722-3, 7731, 7763-8, 77882-4	**Production Technology (PT)** Materials & tools: 2772, 2782, 69561-2, 69564, Process & metalworking machinery: 711, 7248, 726, 7284-5, 73 General industrial machinery: 7413, 7417-9, 7427, 7431, 74359, 74361-2, 74367-9, 7438-9, 7441, 7444-7, 74481, 7449, 7452-3, 74562-3, 74565-8, 74591,74595-7, 746-7, 7482-3, 7486, 7492-9

Source: Delgado, Kyle and McGahan (2013)