CHAPTER 2

China and India Reshape Global Industrial Geography

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China's meteoric climb since the mid 1990s, as an exporter of manufactures, and India's ability, over the past six years to claim a sizable fraction of the global market for tradable IT enabled services[1] have contributed to the changing pattern and the volume of global trade. Some of the implications of these are modeled and described in chapter 3. In 2004, China's share of the world's merchandise exports was close to 7 percent, that of India was a little less than 1 percent. The two countries' shares of global imports were 6.1 percent and 1 percent respectively.

China's manufacturing sector accounts for over 41 percent of GDP and manufactured goods constituted 93 percent of exports in 2005 or almost one quarter of the gross value of industrial output. Machinery and transport equipment accounted for 45.2 percent of total exports. These statistics reflect the large gains in manufacturing capability facilitated by heavy investment in plant and equipment embodying the latest technologies and the codification of knowledge on production processes.

Relative to China, India's formal manufacturing sector accounts for a far smaller share of GDP—less than 16 percent. Investment in new industrial capacity and industrial growth since 1990 has been slower and exports of manufactures are a fraction of China's in absolute terms and also a smaller fraction of total exports. Undoubtedly, India has achieved competitiveness in a few manufacturing subsectors and some of those are technologically quite advanced, as we will discuss below; however, on balance manufacturing capability has lagged. As described later, India's breakthrough is in the exports of certain business process services and software the tradability of which has been greatly enhanced by advances in telecommunications and the advent of the Internet.[2]

These developments point to ongoing and impending shifts in worldwide industrial geography. In this chapter we explore the likelihood of a continuing concentration of major industrial activities in China and India and the implications of such trends, were they to materialize, for other economies.

The balance of this chapter is divided as follows: Section II describes the size of the domestic markets in China and India, especially for the relevant manufacturing products. Section III focuses on the overall strategy and patterns of development in the two countries. In section IV, we briefly examine the development of a few of the leading industrial and service sectors in both

[*] The authors are greatly indebted to Jimena Luna and Wei Ha for their assistance with the research and production, to Richard Cooper, Masahisa Fujita, Nobuaki Hamaguchi, Greg Noble, and T. N. Srinivasan for insightful background papers. We also thank Alan Winters, Tom Rawski, and T. N. Srinivasan for many valuable suggestions which improved contents and structure.

[1] These are principally business processing services and activities associated with the writing, testing and debugging of software.

[2] Exports of not just software and services but also of goods have benefited (Clarke and Wallsten 2006).

countries. Finally, in the concluding section we report on longer term implications for China, India and their trading partners.

Large Domestic Market

The evolving international competitiveness of Chinese industry and eventually of Indian industry, will depend on a number of factors including the expansion of the domestic market, improvements in the infrastructure, strengthening of the innovation system and the dynamism of major firms. Businesses and the press regularly talk about the enormous size of both the Chinese and Indian markets given their huge populations. Large markets create a competitive advantage for any product where there are substantial economies of scale, as is the case for industries such as white goods or automobile assembly. Scale economies can be achieved without a large domestic market, of course, by relying from the start on exports, but access to the domestic market and lower entry barriers can be a significant advantage. But how big are the Chinese and Indian markets?

Table 2.1 Share of China and India in World Exports

World exports	1980		1990		2004	
	China	India	China	India	China	India
I. Manufacturing	0.8	0.5	1.9	0.5	8.3	0.9
1. Iron and Steel	0.3	0.1	1.2	0.2	5.2	1.6
2. Chemicals	0.8	0.3	1.3	0.4	2.7	0.7
2.1 Pharmaceuticals			1.6 [a]	1.2 [a+>]	1.3	1.0 [b]
3 Office machines and telecom equip.	0.1	n.a.	1.0	0.8	15.2	0.6
4. Auto parts	0.0	0.0	0.1	0.1	0.7	0.1
5. Textiles	4.6	2.4	6.9	2.1	17.2	4.0
6. Clothing	4.0	1.7	8.9	2.3	24.0	2.9
II. Commercial Services					2.9	1.9
1. Transports					n.a.	n.a.
2. Travel					4.1	n.a.
3. Other					2.4	3.1

Source: Srinivasan 2006.
Note: n.a. = not available.
a. Pertains to 2000.
b. Pertains to 2003.

For many industrial producers the size of their market is much smaller than the total GDP however measured.[3] Much of what purchasing power a family has is spent on food and not on industrial products. Low income families both in the rural and urban areas do purchase manufactured products such as garments and footwear, but they do not purchase automobiles and the more expensive consumer durables. It is precisely in the area of white and brown goods where economies of scale are important. Thus the market for these latter products is made up mainly of people in the upper income groups with high income elasticities of demand for such products who

[3] For an industrial firm selling its products in the market, the purchasing power parity measure of GDP is irrelevant. A foreign firm in particular will want to know what its sales are worth in a convertible international currency such as U.S. dollars. If a domestic firm is engaged in international trade as either a seller or buyer, it will want to know prices converted into its domestic currency using the official exchange rate. Thus the relevant GDP concept in US dollars is the one obtained by using the official exchange rate.

live in urban areas in China and India or abroad. Data on the ownership of consumer durables and automobiles in China are presented in table 2.3 and for India in table 2.4.

Table 2.2 Share of China and India in World Imports

World exports	1980		1990		2004	
	China	India	China	India	China	India
I. Manufacturing	1.1	0.5	1.7	0.5	6.3	0.8
1. Iron and Steel	2.7	1.0	2.5	1.0	8.2	1.0
2. Chemicals	2.0	n.a.	2.2	n.a.	6.5	n.a.
2.1 Pharmaceuticals			0.9[a]	n.a.	0.8[a]	n.a.
3 Office machines and telecom equip.	0.6	0.2	1.3	0.3	11.2	0.5
4. Auto parts	0.6	0.0	0.6	0.1	1.7	0.3
5. Textiles	1.9	n.a.	4.9	0.2	7.4	0.6[b]
6. Clothing	0.1	0.0	0.0	0.0	0.6	0.0
II. Commercial Services			2.5[a]	2.1[a]	3.4	2.0
1. Transports					4.2	2.2
2. Travel					3.3	2.4
3. Other					3.5	2.1

Source: Srinivasan 2006.
Note: n.a. = not available.
a. Pertains to 2000.
b. Pertains to 2003.

Table 2.3 Ownership of High-Income Consumer Durables in China, 2004

Consumer durable	Urban household (per 100 households)	Rural households (per 100 households)
Washing machine	95.9	37.3
Refrigerator	90.2	17.8
Color TV	133.4	75.1
Camera	47.0	3.7
Mobile PHONE	111.4	34.7
Automobile	2.2	n.a.

Source: National Bureau of Statistics of China, *China Statistical Yearbook 2005*.

How big is the income of these higher income groups or the "middle class" in China and India? One way to approach this question is to measure the income of the highest income 20 percent of the population and the share of that income spent on non-food products. That calculation results in a market purchasing capacity of US$550 billion for China and less than US$150 billion for India. To this figure could be added the share of investment that goes to purchase machinery and equipment, and key inputs such as steel and cement. This would result in a market for industrial products of another US$ 400 billion for China and US$100–150 billion for India.

Thus, industrial producers in China face a potential market of nearly US$1 trillion. Indian industrial producers face a potential market a quarter to a third of that size.

Table 2.4 Percentage of Households Owning the Specified Asset in India

Asset	Total	Rural	Urban
Electronics			
Radio, transistor	35.1	31.5	44.5
Television	31.6	18.9	64.3
Telephone	9.1	3.8	23.0
Transportation vehicles			
Bicycle	43.7	42.8	46.0
Scooter, motor cycle, moped	11.7	6.7	24.7
Car, jeep, van	2.5	1.3	5.6
None of the specified assets	34.5	40.5	19.0

Source: Office of the Registrar General, India 2003.

Two Industrial Giants?

What are the implications of recent trends for the future international competitiveness of Chinese and Indian industry and services and the likely resulting industrial geography?

China Ascending

To begin with, China will remain mainly an exporter of manufactures over the next 10–15 years. As regards imports, China is a major buyer of primary products, of sophisticated equipment and of components such as semiconductors, microprocessors and hard drives. This is already apparent with petroleum, natural gas, iron ore and non-ferrous metals,[4] but it will become steadily more so over the coming decade. In 2005 net imports of crude oil had risen to 127 million metric tons and that upward trend is certain to continue.[5] This rise in imports derives from the rapid growth of Chinese GDP, increasing demand from the transport sector and environmental problems, which is leading a major effort to switch to oil and natural gas ("Today India" 2005; Yusuf and Nabeshima 2006b).[6] A decade ahead in 2015, petroleum imports should be well above 5 million barrels a day depending on the underlying assumptions about the pace and sectoral composition of economic growth.[7]

This demand has increased China's imports from the least developed countries (LDCs). In 2002, China absorbed $3.5 billion in exports from those countries and was their third ranked market (Yang 2006). The main question mark with respect to primary goods imports is the pace at which China will become a major importer of food and related agricultural products. China's grain output peaked in 1996 and 1998 and has fallen since in absolute terms and yet it was still a net exporter of 19.9 million tons of grain in 2003 and only a small net importer of 5 million tons

[4] In 2004, China imported 208 million tons of iron ore, one third of world exports and one fourth of copper exports in 2005.
[5] National Statistical Office, China Statistical Yearbook, 1999, p. 248 and China Statistical Yearbook, 2005, p.256.
[6] A move that is tempered by worries over increasing dependence on energy imports.
[7] Petroleum consumption in 2023 is projected to range from a low of 410 million tons (the slow growth scenario) to a high of 1246 million tons. The latter figure would imply imports of roughly 1000 million tons or 22 million barrels a day (Ho, Jorgenson, and Perkins 1998).

in 2004. China has been a major importer of soybeans, importing more than 20 million tons in both 2003 and 2004. Overall, however, China is still a net exporter of US$9.7 billion of food and live animals as of 2004.

China imports machinery, plant equipment[8] and components which have fuelled the massive expansion of industrial capacity and served as a conduit for technology transfer. The first two, that is, complex capital goods almost exclusively from the advanced countries, are likely to continue over the foreseeable future as China's comparative advantage in these will materialize only gradually given the importance of learning, tacit knowledge, and cumulative research. With regard to electronic components, currently the principal export of several East and Southeast Asian economies, the situation is less clear. They have risen steeply since 1995. China is one of the principal trading partners of the newly industrializing countries and China's openness to trade is contributing to the interdependence of the East Asian region (Branstetter and Lardy 2006; Petri 2006; Yang 2006). More recently however, there is some evidence that elements of the supply chain are migrating to China as manufacturers of intermediates seek to move closer to markets and final assemblers. This process, especially with regard to the auto industry, could fuel FDI in China during the next decade.

On the export side, China is likely to remain competitive in labor intensive products in 2010 or 2015 even as wages rise. In 2004, real wages were 2.11 times the level of 1989 and the rate of wage increase has been accelerating in 2004–2005, especially in the coastal regions—although productivity is rising as well.[9] This trend is likely to be contained because China still has a large overhang of 350 million agricultural workers, many of whose incomes are a small fraction of the wages earned by urban workers.[10] To take full advantage of these underutilized workers as well as lower costs of land , however, China will have to move the labor intensive factories nearer to the interior as is now being attempted in the southwestern provinces through investment in the transport infrastructure (Chan and Qingyang 2006). Assuming it succeeds and the process could take time, China's dominant world position in the export of textiles, garments, shoes, and toys is not likely to change much in the coming years.

China is the second largest market for and the largest exporter of electronics/ICT products (Ma, Ngyuen, and Xu 2006a). The potential growth of these markets has attracted most of the leading Taiwanese, Korean and other MNCs in the electronics, auto and durables subsectors. China's three largest exporters in 2003 were subsidiaries of Taiwanese electronics firms such as Foxconn (Hon Hai) and Quanta. Several auto assemblers and manufacturers of auto parts have shifted their regional headquarters to China and are planning to move some of their research and design facilities as well.

A recent study by Roland-Holst and Weiss (2005) of China's trade shows that it is out competing its ASEAN neighbors. The latter are losing shares in export markets although in absolute terms their exports continue to grow. Rodrik (2006) similarly finds that the growing sophistication of China poses a considerable challenge for other Southeast Asian countries.

[8] Imports of machinery and transport equipment by China in 2004 reached $253 billion as against just $22 billion by India (Panagariya 2006).

[9] These are the Chinese official wage indexes for enterprises in the urban areas see National Statistical Office, China Statistical Yearbook 2005, p. 151. This is the change in the real average wage of all workers and staff so it includes both wage increases within various job categories and changes in the share of particular job categories in the wage bill.

[10] The marginal return to labor in 2001 was 365 RMB in agriculture, while it was 11,884 RMB in urban industry, 4,672 RMB in rural non-farm, and 2,009 RMB in urban services, pointing to large distortions in the labor market, especially between agriculture and urban industry. This disparity has increased from the ratio of 11.4 in 1978 to 34 by 2001 (Tan 2004).

Table 2.5 Shanghai and Beijing Emerging as Asian Regional Headquarters

Corporation	Presence in Asia
Toyota Motor Corp.	Plans to set up regional headquarters in Beijing to supervise and coordinate sales, distribution and other operations.
GM	Will shift its Asia Pacific HQ from Singapore to Shanghai by January 2005.
Visteon	Has moved its Asian HQ from Tokyo to Shanghai
Volkswagen	Has moved its Asia Pacific regional center to Beijing from its German HQ at Wolfsburg.

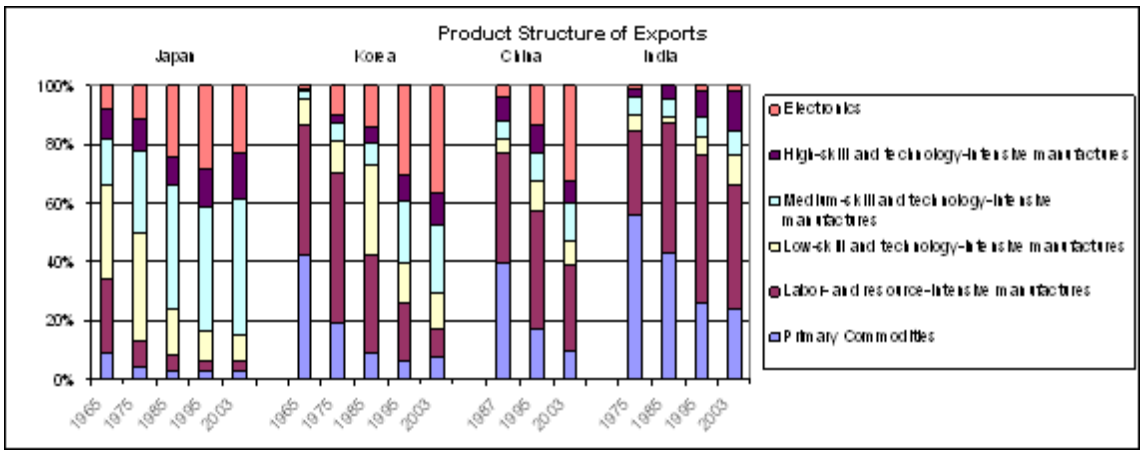
Source: Asia Pacific Foundation of Canada 2005.

With over five million graduates a year in senior secondary school, the Chinese labor force is going to have a large number of people capable of taking on jobs well above the low skilled labor intensive assembly operations associated with light manufactures.

China's gross enrollment rate for higher education rose from 19 percent in 2004 to 21 percent in 2005 (Min 2006).[11] Currently China is graduating 600,000 people in science and engineering mainly at the undergraduate level. Over the next decade that number could reach a total of more than 5 million ("Up to the Job?" 2006). The very top Chinese students in sciences and engineering (like those from India) are competitive with the best in the world and are beginning to make a mark through scientific publications and patenting (Chen and Kenney 2006). The increasing stock of engineers and scientists is now enabling China to enter a limited number of higher technology areas (such as nanotechnology, see Zhou and Leydesdorff 2006) at an earlier stage of development than would be the case in a smaller country. Significant numbers of graduating students can staff world class research laboratories abroad and should enable China to enter other high technology fields provided that these experienced researchers come back to China after years studying abroad. The lure is rising R&D, which reached 1.4 percent of GDP in 2005 as against 1 percent in 2000 together with numerous incentives for returnee's with S&T skills (Yusuf and Nabeshima 2006a; Yusuf and Nabeshima 2006b; Yusuf, Wang, and Nabeshima 2005).

[11] Data from UNESCO Institute for Statistics, 2006.

Figure 2.1 Product Structure of Exports



Source: UNCTAD 2005.

There remains a question about the quality of the graduates from many Chinese tertiary institutions. Based on surveys by McKinsey, it does not seem to be particularly high. Only 10 percent are seen as being sufficiently well trained to be hired by multi-national companies in China ("China's Hi-Tech Success" 2005). These graduates (along with graduates in less technical fields) have to staff managerial and technical jobs in over 200,000 industrial enterprises, a wide variety of service sector businesses, government agencies, and universities. The quality of technical graduates in India is not much better. Possibly 20 percent are world class and three-fifths, according to a recent survey, are "lamentable" ("Now for the Hard Part" 2006; "Up to the Job?" 2006).

What Is India's Model for Catching Up?

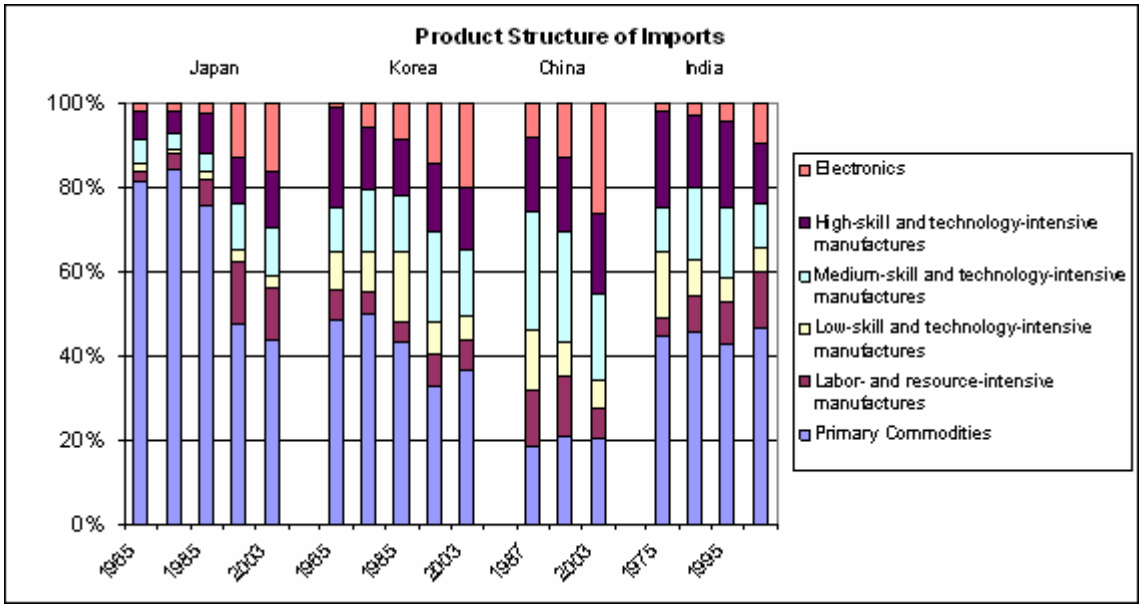
As noted above, relative to China, the Indian business environment has been less conducive to the growth of manufacturing and exports and this is immediately apparent from the stark contrast in absolute numbers from the two countries as well as from the shares of manufacturing production and the volume of exports of manufactures. Hence, India's impact on the rest of the world has been modest for a country of its size—at least as measured by population. Among its exports of manufactures,[12] only textiles has achieved a scale sufficient to impinge on the prospects of other Asian countries, producers elsewhere, and the market for raw cotton. IT enabled services is the only other area in which Indian exports have established a substantial and growing presence. Because of the still relatively small size of the economy, the modest level of industrialization and of automobile use, India's imports of raw materials, machinery, intermediate products, and consumer goods are smaller than those of comparators such as Brazil, Mexico, and Korea which in terms of GDP at constant dollars were approximately comparable in 2004.

[12] India's leading (commodity) export item is gems and jewelry which competes with exports from Thailand but with few others India may have a lot of catching-up to do here in terms of both quantity and quality, which is worrying top companies such as Infosys.

Undoubtedly, India's global footprint has expanded since the beginning of the decade. Looking forward, India's economy and trading relations will become more visible on the global stage, but even a doubling of GDP in ten years will result in an economy that is less than two-thirds the size of the Chinese economy today, in nominal dollars. However, India's future impact on the rest of the world needs to be taken seriously because it has the labor resources, a growing base of human capital, the domestic market potential, and the nascent industrial strength to become an industrial powerhouse comparable to China today. Whether this actually materializes and India begins to significantly influence the fortunes of other countries as well as a natural resource use and global externalities, will depend upon the competitiveness and dimensions of a number of industrial subsectors. This appears unlikely.

Were India to proceed along the growth path chalked out by the dynamic and fast growing East Asian economies, then manufacturing must lead the way. Given its factor supplies, India would need to rapidly expand its labor intensive consumer industries while continuing to build the basic materials industries such as petrochemicals and metallurgical, as well as the downstream engineering and transport industries. Moreover, while the domestic market is and would remain a major outlet for all these industries, rapid growth is likely, as in the case of China, to rest upon FDI in manufacturing industries and success in export markets.[13] If India is to conform to the East Asian model, the share of manufacturing in GDP, currently less than 16 percent, would need to double within possibly a decade and a half, calling for sector growth rates in the double digit range, which also would help generate urgently needed jobs ("India: Risks Mount" 2006), and a significant portion of the output produced would have to be exported.

Figure 2.2 Product Structure of Imports



Source: UNCTAD 2005.

[13] The low level of FDI in Indian industry relative to China's has influenced the development of the manufacturing sector and growth of exports (Mukherji 2005; Swamy 2005; and Huang and Khanna 2005).

A second and untried model would project growth on the basis of high and accelerating expansion of the services sector fuelled by domestic and international demand. That key services subsectors could lead growth is certainly plausible. Overall, services is by far the largest part of the Indian economy (50 percent), some parts have been expanding at a rapid clip, and there is much scope for increased investment as well as gains in productivity (Gordon and Gupta 2005).

These two models have different implications for global industrial geography and for India's impact on the rest of the world. Which one is more likely rests again on the future industrial capability of key subsectors, their competitiveness and on the demand for their products—domestic and foreign.

Table 2.6 GDP of India, China, and Other Countries
Constant 2000 US$ billions

Country	1990	1995	2000	2004
India	268	345	457	581
China	413	727	1,081	1,506
Korea, Rep.of	284	413	512	613
Indonesia	109	159	165	197
Brazil	461	538	602	657
Mexico	414	446	581	619

Source: World Development Indicators.

It is easier to tackle the second model. Around 1990, India's services sector had a share in total GDP similar to that of other countries in an equivalent income level. Since then, it has risen at an above average pace and the share in 2005 was higher than the norm for lower income countries but not too far above this norm. This growth has been spearheaded by business services and software and Indian firms now rank among the largest in the world. As a share of the services sector GDP as a whole, IT services account for 6 percent and in 2004–2005, and had revenues of $30 billion ("Now for the Hard Part" 2006). Exports reached $12 billion in 2003–2004. Both turnover and exports have risen swiftly since 2000, averaging 30 percent and 31 percent per annum respectively. Employment too has climbed and is now a respectable 3 million. However, employment in the IT sector as a share of the total is miniscule and concentrated in five or six urban centers. Exports of business services are less than 3 percent of the global total. In other words, the performance in the past five years is remarkable in the context of the Indian economy, but the sector is still fairly small and the capability of the services sector as a whole does not extend much beyond software application development and maintenance (ADM) and low value added processing services (financial, legal, medical accounting and others). Call center services, professional services, document entry and transcription, [14] and software maintenance activities dominate rather than the design of computer architecture and operating systems. That this has been achieved in a short span of time points to the latent capability which could evolve rapidly spurred by the activities of India's homegrown firms such as TCS and Infosys as well as of MNCs which are expanding their presence in India. Intel's largest chip design center is in Bangalore and both IBM and Cisco have opened major chip design facilities there as well, with

[14] See "Life on the Web's" 2006.

AMD and TI planning to follow (Arora and Gambardella 2004; "Big Players in Chip Design" 2006; D'Costa 2006).

Software and IT-Enabled Services

The roots of Indian software/business-processing services sector reach back into some decisions taken many decades ago and other developments in the more recent past. In early 1950, the first Indian Institute of Technology modeled on MIT was established at Kharagpur in West Bengal followed by six other IITs that were set up in selected cities across the country following the passing of the Indian Institute of Technology Act in 1956. The seven IITs with a total student body now approaching 30,000 (17,000 undergraduate and 13,000 graduate students) have provided India with the nucleus of a world class technological elite. These schools and other training institutions such as the six Indian Institutes of Management (IIMs) and several Indian Institutes of Information Technologies (IIITs) in conjunction with the universities, have provisioned India's labor markets for engineering, management and IT relevant skills. India's capacity to train accredited engineers rose from 60,000 in 1987–8 to 340,000 in 2003. For IT professionals, it rose from 25,800 to 250,000 (Arora and Gambardella 2004). In addition, the many graduates from the IITs who work abroad or have studied and worked abroad have contributed to the growth of the IT services industry in three substantive ways. First, the quality of their training and skills has created a positive reputation in North America and the U.K. and now more widely. Second, many of these former graduates after acquiring further education and experience abroad, have returned to India and are setting up their own businesses or working for firms, local and multinational, operating in India. In fact, 71 of 75 MNCs operating in Bangalore's software park were headed by an Indian who had lived overseas, and many of the smaller companies are owned by Indian entrepreneurs residing in the U.S. And third, the Indian diaspora of professional and business people has shown great initiative in creating opportunities for Indian firms, and funneling contracts to them. As a source of capital, expertise and guidance on technologies the Indian diaspora is second only to the Overseas Chinese and much like their Chinese counterparts, they have become increasingly adept in playing the role of intermediaries, venture capitalists, and angel investors with secure footholds in strategic clusters such as Silicon Valley and in the Boston area (Saxenian 2006).

Indian firms were motivated to look overseas for business because the domestic market in the 1980s and 1990s for their services, was very limited. The links forged with major U.S. companies that established subsidiaries in India led to a buildup of contact, usually on-site work, done by Indian professionals for American firms on software enhancement and maintenance, the writing of code, engineering design and other related projects which harnessed specific skills that were plentiful and very low priced.[15] On site work at the facilities of American companies was also made necessary by the shortage of computer hardware in India, a shortage caused by steep duties and other restrictions on imports.

The falling cost of telecommunications and the vistas opened by the Internet made it feasible to outsource a host of services: back office services, information processing of all kinds, engineering and some kinds of retail,[16] and medical services, particularly in the United States. Not

[15] The Y2K threat and the Euro conversion greatly expanded the demand for technicians to write code and debug software.

[16] Just 3 percent of India's retail business is conducted by big chain stores and shopping centers (although chains such as Big Bazaar and Pantaloons, and malls such as Phoenix-Mills are multiplying) as against 20 percent of China's ("Here Comes" 2005).

many countries had the mix and volume of skills and English language capabilities which India did. Moreover, Indian IT professionals and companies had the added advantage of long exposure and involvement with U.S. companies which took the lead in adopting IT, in reengineering corporate structures, and in outsourcing services.[17] It was during this period that more and more Indian firms began to enter the field and IT services clusters (for instance in the software parks) began to take shape in Bangalore and other cities with a concentration of engineering talent (Arora and Athreye 2001) However, the growth of the industry was spearheaded by a number of medium sized firms established much earlier: The first, Tata Consulting Services was created in 1968, Wipro in 1980, Infosys in 1981, and Satyam in 1987. The leading firms now account for the lion's share of turnover and exports (Khanna and Palepu 2004). Only one-fourth of the top twenty exporters are foreign multinationals. Thus the past association dating back to the 1980s and reinforced by the presence of thousands of Indian professionals in the U.S., gave Indian firms a flying start in the global market place and accounts for the heavy dependence on exports and on the U.S. market. The government assisted by containing the rates for telecommunication services and modifying India's stringent labor laws so as to give IT firms greater flexibility in the hiring and laying off of workers.

As the IT sector has expanded one of the most serious constraints which has emerged is the shortage of needed technical and managerial skills which goes hand in hand with high and disruptive labor turnover. Thus, India needs to invest heavily in skills and in technology and firms will need to cultivate links with universities and research institutes if they are to sustain high growth rates.[18] Other middle income countries are also looking to services to provide economic momentum and jobs—the East European economies, Russia, Brazil, Mexico, not to mention China which is producing more engineers and IT technicians than India and is ambitiously expanding the ITES and software sectors assisted by FDI by Indian IT firms ("Watch Out, India" 2006). India can also expect to encounter strong competition from Israel, Ireland, several European countries and the U.S. as it pushes into the high value end of IT which it is now attempting—for instance with digital signal processing software. Hence projecting the likely future geographical distribution of business and IT services is no easy matter. However, it is beginning to seem as though other South East and South Asian economies and those from East Europe and Latin America will have to struggle to find lucrative niches in the IT services market dominated by MNCs and Indian firms.

Other Services

India's banking, finance, telecommunications, and hotel and restaurant services have also grown at double digit or near double digit rates (Gordon and Gupta 2005). There is plenty of scope for the development of India's finance, telecoms, commercial and retail, medical, moviemaking, and logistics services on the strength of buoyant domestic demand as well as demand from overseas. Each of these also stands to benefit from advances in IT which will both raise productivity and generate demand for the firms supplying the services. It is an open question however, whether India is likely to emerge within the next decade as a significant exporter of any of these services. India's economy is only a sixth as monetized as China's and India holds 1 percent of the global financial assets but less than one-half are in the form of bank deposits (Farrell and Key 2005).

[17] During 1999–2001, roughly half of the petitions for H1B visas (work authorization for skilled workers in the United States) were granted to Indians (Cooper 2006).
[18] Only a small fraction of those employed by the IT industry have more than five years experience ("Now for the Hard Part" 2006; "Up to the Job?" 2006).

India's banking and finance sector while improving and apparently more dynamic than China's remains inefficient by international standards and Indian institutions have not made any headway overseas.

Telecommunications also is a domestic industry even though India has created a production base for hardware technologically attuned to the needs of lower income countries. But unlike Chinese firms such as Huawei and ZTE, Indian companies have yet to venture abroad, offer the kind of full service (including financing) packages which Chinese firms now do and to invest significant sums equal to 8–10 percent of sales in R&D to stay abreast with the frontrunners in this rapidly advancing field ("Global Transformation" 2006).[19]

Moviemaking is a thriving national industry and India is the biggest producer of films in the world. This industry also caters to the large overseas Indian diaspora and has acquired a niche market in some of the Middle Eastern countries as well. But it has yet to broaden its appeal to consistently reach a global audience and compete with Hollywood or with producers in Greater China (China, Hong Kong and Taiwan, China) and Korea in spite of the international acclaim enjoyed by a few movies, most notably *Bend It Like Beckham*.

Very recently, Indian firms have begun supplying IT services for the international movie industry and producers of video games (for example, for cell phones), a business that could grow in line with the demand for special effects and video content. With the exception of the business services processing and software industries, it is far from obvious that India is positioned to make a mark in the global market with its services industry at least during the next ten years. Very likely, India's impact and China's on the geography of the world's tradable services industry could be modest and not especially disruptive. The same cannot be said for manufacturing, if India picks up speed. This brings us back to the conventional manufacturing sector led model of development which underlies the development of China and other East Asian economies.

Prospects of Key Manufacturing Industry

Whether Indian manufacturing can become the principal leading sector and whether India can join China as a leading industrial economy will depend in both countries, largely on the medium term performance of a number of manufacturing subsectors and in India's case in particular, the parallel development of infrastructure.[20]

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[19] The average investment in R&D as a percent of sales in 2000 by Indian software firms was 3.5 percent (Radhakrishnan 2006).

[20] Power shortages are a major concern for Indian firms. A survey of Indian manufacturing firms in 2003 reveals that 61 percent of firms still rely on their own generators for electricity while in China, the share is 27 percent. The same survey also found that firms in India faced 17 significant power outages a month on average, far more frequent than in Malaysia (once a month) or China (less than five a month). The loss due from power outages in India was 9 percent of total output compared to 2 percent in China (World Bank 2004). Furthermore, electricity cost twice as much as in China ("An Urgent Political and Moral Imperative" 2006). In addition, investment in infrastructure has lagged behind the urban population growth of 31 percent between 1991 and 2001 ("India: Poor Infrastructure" 2006). Major cities are only now embarking on various infrastructure projects (transport, roads, electricity, and water) to ameliorate the current conditions. Deficiencies in infrastructure provisions are costing India 3–4 percentage points in lost growth ("An Urgent Political and Moral Imperative" 2006). China has invested more heavily in infrastructure and many regard infrastructure provision as adequate and improving (Dollar and others 2003). Still China faces serious transportation constraints. Rail bottlenecks remain severe and feeder roads require a further dose of investment ("China: Rapid Growth" 2005; "China: New Roads" 2006). Overall in 2003, India was investing 3.5 percent of GDP or $21 billion in infrastructure, China 10.5 percent or $150 billion. This divergence is tellingly apparent in the current outcomes ("Now for the Hard Part" 2006).

These subsectors are: textiles, white goods, pharmaceuticals, autos and auto parts, steel and electronics. Together, these account for close to a third of the merchandise exports of both India and China and for 48 percent of the sales of industrial products in China as well as 41 percent of industrial employment (see table 2.8).

Textiles

Textiles and clothing account for 7 percent of world exports. China is the leading producer, followed by India. China's advantage derives from its integration with the global production network through foreign investment and direct contacts with the retailers in OECD countries. Wal-Mart for example, purchased $18 billion worth of goods from China in 2004. In contrast, India is not yet an integral part of global production networks and has little direct contact with the retailers (Whalley 2006).

Domestically, India's textile and clothing sector is the second largest employer with 35 million workers (10 percent of the workforce) (Ananthakrishnan and Jain-Chandra 2005). In 1950, India was a leading exporter of cotton textiles, but thereafter it lost ground and the industry's fortunes only began once reforms were introduced in the early 1980s (Roy 2004). However, India's textile industry still trails well behind that of China. In 2005, exports of textiles and garments amounted to $9.5 billion and $7.5 billion respectively versus $77 billion and $40 billion for China. The average firm in the formal sector has often been constrained from fully exploiting scale economies and new technologies; little foreign capital has flowed into the sector; Indian firms are less well integrated into global production networks than Chinese firms and for that reason, have benefited less from technology transfer. Hence, the productivity level of Indian textile and clothing sector is only 35 percent of that of the United States while China's is 55 percent (Ananthakrishnan and Jain-Chandra 2005). The overall productivity of India's apparel industry is 16 percent of that of producers in the U.S. (Padhi, Pauwels, and Taylor 2004).

As with several other Indian industries, the partial dismantling of domestic regulations and of the MFA, have created openings which firms are rushing to exploit. Indian exports some of which compete against exports from China are rising and the two countries are moving to dominate the world market to an even greater extent than in the past. Both increased their market shares in Japan, the EU, and the United States in 2005, however, China's gains were larger because Chinese producers had invested in anticipation of the lifting of quotas, were better prepared and more competitive ("Air-conditioners Wilt" 2005; "India: China Eats" 2005; Yang 2006). As the backloaded MFA phase out started in 1995, China, even though it was not yet a member of the WTO, was able to take advantage of the phased removal of quotas on various apparel categories. India did not (Srinivasan 2003; Srinivasan 2006).

Even if there is a full liberalization, India may not soon be able to take advantage of the opportunities made available because Indian firms are still hampered by suboptimal scales of production, labor market rigidities and other impediments to trade, particularly with respect to logistics (Schiff and others 2006).[21] The minimum delivery time from India to the United States is 24 days, compared to 18 days from Thailand, 15 days from China, 12 days from Hong Kong (China), and 3 days from Mexico. In addition, custom delays on imports eat up 10 days in India as opposed to 7 days in Korea and Thailand (Ananthakrishnan and Jain-Chandra 2005).

[21] Even large firms such as Gokaldas is unwilling to expand employment because it is difficult to lay-off workers ("Now for the Hard Part" 2006).

Table 2.7 Industry Export as a Percentage of Total Exports, China and India

China	**1995**	**2000**	**2004**
Pharmaceutical products	1.06%	0.72%	0.55%
Iron and steel	3.51%	1.76%	2.34%
Electrical equipment	5.94%	9.64%	10.03%
White goods	0.67%	1.12%	1.26%
Road vehicles	1.81%	2.63%	2.76%
Textile	26.03%	21.38%	16.22%
India	**1995**	**200**	**2004**
Pharmaceutical products	2.28%	2.77%	2.87%
Iron and steel	2.97%	2.89%	5.98%
Electrical equipment	1.33%	1.84%	1.92%
White goods	0.03%	0.04%	0.07%
Road vehicles	2.77%	2.02%	2.80%
Textiles	27.00%	27.17%	17.37%

Source: World Integrated Trade Solution, World Bank.
Note: Textile is defined as the combination of 26, 65, 84 of SITC Rev.3. White goods is defined as the combination of 7751, 7752, 7753, and 7758 of SITC Rev.3. Pharmaceutical products, iron and steel, electrical equipment, and road vehicle are defined as 54, 67, 77, and 78, respectively, of SITC Rev.3.

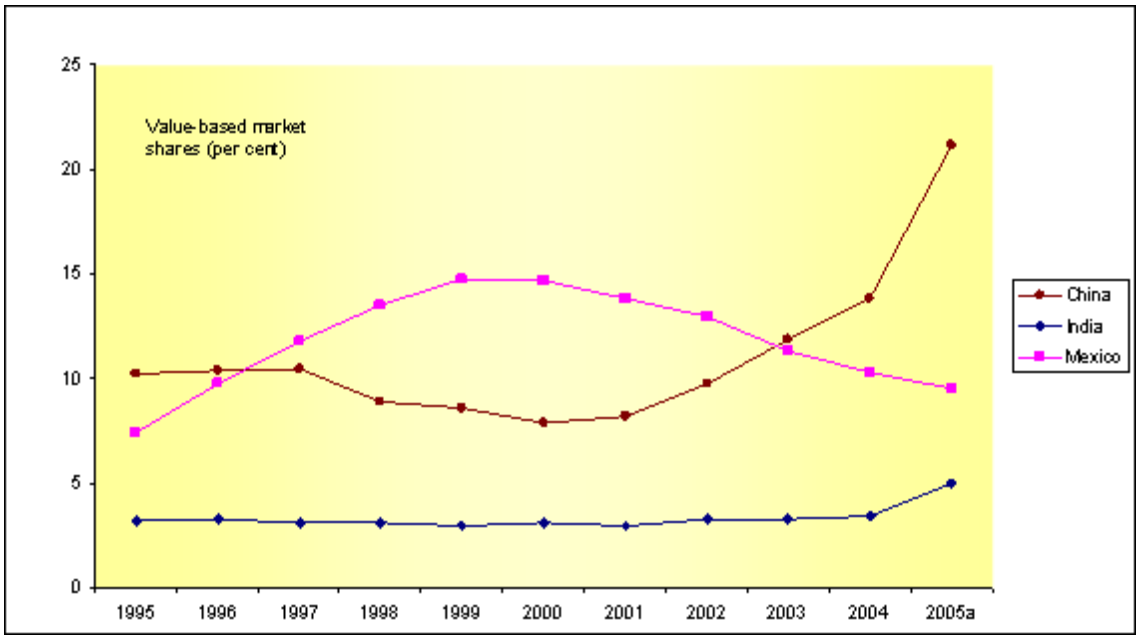
Table 2.8 Main Indicators of All State-Owned Enterprises and Non-State-Owned Enterprises above Designated Size, by Industrial Sectors, 2004

Grouped by Sector	**No. of enterprises**	**Percent of total enterprises**	**Sales revenue of industrial products (billion yuan)**	**Percent of total sales**	**No. of employees (10,000 persons)**	**Percent of total employment**
Manufacture of textile	17144	7.81%	934.7	4.98%	519.2	8.51%
Manufacture of textile wearing apparel, footware, and caps	10901	4.97%	388.0	2.07%	320.3	5.25%
Manufacture of raw chemical materials and chemical products	15172	6.91%	1198.3	6.38%	315.7	5.18%
Manufacture of medicines	4397	2.00%	321.3	1.71%	118.5	1.94%
Smelting and pressing of ferrous metals	4947	2.25%	1590.7	8.47%	261.4	4.29%
Manufacture of transport equipment	9389	4.28%	1327.2	7.07%	327.5	5.37%
Manufacture of electrical machinery and equipment	11760	5.36%	1005.6	5.35%	298.6	4.90%
Manufacture of communication equipment, computers and other electronic equipment	6638	3.02%	2146.3	11.43%	333.4	5.47%
Subtotal of these selected sectors	80348	36.6%	8912	47.5%	2494	40.9%
National total	219463	36.6%	18781.5	47.5%	6098.6	40.90%

Source: National Bureau of Statistics of China, *China Statistical Yearbook 2005.*
Note: The designated size here means the sales value has to be greater than 5 million yuan.

Looking ahead India—and China—will most likely remain among the most competitive producers of garments and textiles because of an elastic labor supply, assuming that labor laws and shortages do not serve to push up wages more rapidly than what has occurred over the previous decade. The latitude for raising productivity, quality and design in the industry is considerable. Niche products will surely continue to offer opportunities for suppliers in other countries,[22] but even in the high value textiles and fashion garments produced by Italy, pressure from India and China will mount given the levels of investment, the design and engineering skills being mobilized locally and from overseas sources (as the design industry is becoming globalized and design services can be outsourced), the increasing sophistication of domestic consumers, and the immense domestic markets. This is strikingly supported by China's capacity to diversify its product offerings in textiles and entire new markets. Since 1990, at the 10 digit level the number of textile product varieties has risen from 6,602 to 12,698 (World Bank 2006).

Figure 2.3 U.S. Apparel Imports from Selected Sources, Market Shares, 1995–2005



Source: UNCTAD 2005.
Note: From January to May 2005.

White Goods

The market for white goods worldwide amounted to over $100 billion in 2002. One third of demand for large appliances came from the Asia Pacific region, of which half came from China, the fastest growing market (Nichols and Cam 2005). Seeing the opportunities, foreign firms are

[22] For instance, knitwear from Bangladesh and carpets from Pakistan has held up well so far in the U.S. and EU market after the abolition of MFA (Whalley 2006).

entering the Chinese market, and in durables such as washing machines their market share has increased from 15 percent in 2000 to 25 percent in 2003 (Nichols and Cam 2005). Firms such as GE are planning to shift a third of their production capacity to Asia, China being the primary destination.

Similarly, the Indian market is expanding and domestic producers such as Godrej and Videocom and MNCs have created two large clusters to produce white goods in Noida (near Delhi) and Pune (near Mumbai) assisted by government provided incentives. The household ownership rate for refrigerators in India was just 15 percent in 2004 and it was also low for other durables ("Japanese White Goods" 2006). Haier is attempting to enter the Indian market where Korean producers (such as LG the market leader and Samsung) currently have a strong presence. In 2004, LG announced plans to make India its second largest global production base after China (Nichols and Cam 2005). It already accounts for more than a quarter of the market for air-conditioners and color TVs, and more than a third of the market for washing machines, refrigerators, and microwaves ("Now for the Hard Part" 2006). Sanyo will start marketing white goods in India, utilizing existing partnership with local distributors for their TVs ("Sanyo Seeks India Boost" 2006). So also are Sharp and Toshiba ("Sharp India Chalking Out" 2006; "Toshiba Forays" 2006).

In the past, local production was the rule worldwide because of freight costs. As freight charges are typically quoted with reference to cubic capacity, it is relatively expensive to ship finished white goods over a long distance, especially the larger ones (Nichols and Cam 2005). Because of this, the development of the white goods industry was determined by the size and the growth opportunities of the domestic market. However, the combination of low wages and production costs coupled with adoption of modern technology, has enabled China to export refrigerators and wine coolers to the US (Nichols and Cam 2005). Parallel to the increase in trade of finished goods, intra-industry trade has increased, reflecting the development of global production networks for white goods.[23]

Although demand is strong, especially from China and India, the unit price of white goods has been in decline and firms are adopting a number of strategies to cut labor costs, to outsource, to strip production down to an assembly operation, and bring in modern management techniques, especially total quality management to reduce the number of defects (Nichols and Cam 2005). Others are trying to move up the technology ladder by offering more functions in each unit, better designs, integration with the whole kitchen as a system, and even internet-enabled refrigerators (Nichols and Cam 2005).

China

In 1981, the urban penetration rate in China of refrigerators and washing machines per 100 families respectively was only 0.2 and 6. The "big three" home appliances at that time were the bicycle, the watch, and the sewing machine (Zhao, Nichols, and Cam 2005). In 20 years, the penetration rate of white goods in China increased dramatically to reach 87 refrigerators and 92 washing machines per 100 urban families in 2002. In some cities such as Beijing, the penetration rate was 107.4 refrigerators and 102.8 washing machines per 100 families (Zhao, Nichols, and Cam 2005). Although the urban market is fast becoming saturated, the ownership of white goods by rural households is still low with 13.6 refrigerators and 29.9 washing machines per 100 rural families (Zhao, Nichols, and Cam 2005).

[23] For instance, Maytag's dishwashers that are assembled in the U.S. use motors made in China (by GE), and wire harnesses from Mexico (Nichols and Cam 2005).

At the beginning, most firms were small-scale state-owned or collectively-owned enterprises. To meet the rising demand, these firms imported factories from Italy and Germany. By the mid-1990s, more than 100 lines were imported. During the 1990s, more successful enterprises, with government encouragement started to acquire other companies, forming several large well-known firms such as Haier, Kelon, Meiling and Little Swan, reflecting the worldwide trend in consolidation (Zhao, Nichols, and Cam 2005). By 2002, the market share of the top five firms had risen to 60 percent in refrigerators and 68 percent in washing machines. The market for air conditioners is also becoming less crowded. Twenty-seven brands were withdrawn in 2001 leaving 69 in 2005. By the end of 2006 only 20 might be left ("Air-conditioners Wilt" 2005). These successful firms are also relying heavily on exports. For example, Galanz exports 65 percent of its production of microwave ovens and is becoming a major producer of air conditioning units ("An Alpha Delta" 2006; Sull and Wang 2005). Changhong Electric is also expanding its production of air conditioners ("Telecoms and Technology" 2006). But many of the Chinese producers depend upon foreign firms for key items such as compressors.

Haier, now the fourth largest white goods manufacturer in the world, was the first Chinese manufacturing firm to invest abroad in 1999 ("Haier to Create" 2006).[24] It is also the first Chinese firm to hire an international advertisement agency to establish its brand ("Chinese Fridge Magnate" 2005), and now has dozens of factories scattered overseas.

India

India's white goods industry is at an earlier stage of development relative to China's. Exports are insignificant and there is no Indian equivalent to China's Haier prowling international markets. Protectionism, slow growing demand from the middle class, little FDI until recently, sub-scale production and inadequate supplies of electricity all have combined to keep India out of the running. Now, demand from the middle class is picking up and the white goods industry has seen double-digit growth in recent years. The market size of white goods is about Rs. 80 billion (US$1.76 billion).

MNCs are expanding their manufacturing capacity in India. However, while India is attracting assembly operations, its slow start means that producers based in India are unlikely to be exporting substantial quantities of finished products for some time. The exports of components is a different matter and feasible. China has established a lead in white and brown goods and it could be a lengthening lead as MNCs transfer more and more technology and expand capacity through FDI in China.

Pharmaceuticals

Pharmaceuticals is one of India's brightest prospects and is underpinned by strong entrepreneurship in the private sector and the abundance of skills in chemistry, biology, and chemical engineering and also the long term mastering of complex process technologies made possible by the absence of IP protection until recently under Indian laws for foreign pharmaceutical products (Chaudhuri 2004). Here again, China is a close match although its corporate capability is weaker than India's. India is the fourth largest producer of pharmaceuticals

[24] This investment was in a factory in South Carolina, United States. Haier plans to expand the existing factory with additional investment amounting to $150 million. Furthermore, it plans to invest in an R&D facility in the United States ("Haier to Create" 2006).

by volume—the 13th in terms of value—and for several compelling reasons it is likely not only to retain this ranking over the next decade but also to expand its global market share (Grace 2005). China is the second largest producer of pharmaceutical ingredients and generic drugs in terms of value after the U.S. (with 5 percent of world output in 2004 valued at $54.4 billion ("China Pharmaceuticals Sector" 2005) but Chinese firms have, remarkably, shown less initiative in this field than in others, although they exported $4 billion worth of products (including traditional medicines) in 2004 and are now beginning to move into the neighboring fields of biotech and stem-cell research (Fernandez and Underwood 2006).

In addition to graduating 15,000 chemists each year, India has the corporate muscle to invest in R&D, to test, and to market drugs. Firms such as Ranbaxy, Cipla, Dr. Reddy, Wockhardt, and Nicholas Piramal have the size and the experience to embark on substantial research activities involving drug discovery, a significant departure from their past practice of imitating drugs produced abroad and selling mainly in the market for generics.[25] Indian companies currently account for $8 billion of the $48 billion global market for generic drugs ("Selling Generics" 2006). The presence of these homegrown firms plus many MNCs such as Novartis and GlaxoSmithKline which are beginning to locate some of their research in India is creating a dynamic environment. India's huge size, numerous hospital facilities and the capacity to conduct drug trials involving a large and heterogeneous population is another advantage over smaller countries such as Singapore and Korea which are also engaged in the development of new drugs and procedures. Developing a drug in India can cost as little as $100 million vs. $1 billion or more in the U.S. China shares these advantages and is beginning to exploit them (see Yusuf and Nabeshima 2006a).

India now has the largest number of FDA approved manufacturing plants outside of the U.S. and these factors plus the newly strengthened IP regime are a firm basis for future growth.[26] Again, the competition is likely to be among the advanced countries, China and India possibly also Brazil, with other countries certain to be squeezed by the presence of the big players in an industry, where size matters a great deal at several levels.

Autos and Parts

Traditionally, automobile firms have tended to prefer local assembly to exporting because of the bulkiness of the finished cars and the need to comply with local regulations that often differ substantially among countries. This is not to say that the trade in the automobile sector is insignificant. On the contrary, it is growing at double digit rates, especially that of more sophisticated and expensive parts.

In 2004, the Chinese share of automotive products exports was a mere 0.7 percent while that of India was 0.2 percent (Noble 2006). However, the Indian production of automobiles could climb to about $40 billion in 2015 (today it is about $9 billion), of which $20–25 billion would be exported. By 2015, China's export of automobiles could be as much as $120 billion (Noble 2006). India seems to have a comparative advantage in exporting small cars[27] although the recent entry of Chinese producers such as Chery and Geely could change the picture as could the strategies of MNCs to use China as a base for producing and exporting small cars, including

[25] Until the revision of IPR in 2005, Indian firms were able to manufacture generic versions of medicines developed in other countries, without the need for the expiration of patents for these drugs.
[26] Surprisingly though, a survey by Bain and Company in 2006 found that pharmaceutical executives felt China was the more attractive site for low cost manufacturing of drugs ("China Looms Large" 2006).
[27] Just seven years after it commenced production, Tata Motors was making net pre-tax profits of 10 percent and was the largest group in the Tata business empire ("Today India" 2005).

hybrids (Ma, Ngyuen, and Xu 2006b).[28] China and India are both modernizing their auto industries through joint ventures with foreign firms. Virtually all the major international auto manufacturers have set up facilities in China and some such as Honda, Hyundai, Toyota and others are entering India ("Honda to Invest" 2006). For example, the Indian government partnered with Suzuki in the early 1980s to form a joint venture, Maruti Udyog, and began delicensing the auto components industry (Gokarn and Vaidya 2004).[29] In 1993, India ended licensing of foreign automobile ventures and in 2001 it lifted almost all the restrictions on FDI in the automobile industry. However, tariffs have remained high at 100 percent on vehicles and 35 percent on parts. In contrast, tariffs in China declined to 25 percent on vehicles and 10 percent on parts after the accession to the WTO (Noble 2006).

FDI from MNCs is spurring the emergence of parts manufacturers in China (some of them foreign affiliates) (Noble 2006; Rawski 2006). China is acquiring an edge in the international market for auto parts with exports of $0.3 billion in engines, $3.25 billion in auto parts and bodies, and $1.35 billion in tires as opposed to $800 million for India for these products (Balakrishnan and others 2006). The assemblers and first tier suppliers (Sutton 2004) in both countries are able to manufacture products of sufficient quality no matter where they are produced and are able to export their products.[30] The distribution of defects observed confirms the view that first-tier suppliers to newly arrived carmakers in India and China are already operating close to world-class standards (Balakrishnan and others 2006). However, India's auto industry is handicapped by a significant cost disadvantage relative to China: costs are close to 20 percent higher in almost all the parts and component production.

In both China and India, auto assemblers are facing difficult times in procuring parts of sufficient quality from the lower-tier suppliers (Noble 2006). Recently, the Indian automobile parts industry has redoubled its efforts (the pressure mainly coming from MNCs) to improve quality, to streamline the delivery system (just-in time), and to improve the efficiency of their factory operations (Balakrishnan and others 2006).

In the push to raise the level of technology, China is ahead of India. The automobile industry is one of the most R&D intensive.[31] The list of top R&D spenders includes many of the well-known automakers some of which have transferred a portion of their R&D activities to China. Chinese automakers are also slowly increasing their R&D spending (for instance, Geely claims to invest more than 10 percent of revenues on R&D) (Noble 2006). By comparison, Tata Auto spends about 2 percent of revenues on R&D and Maruti Udyog spends only 0.48 percent on R&D.[32] This may change as Indian engineering and metal working firms such as Bharat Forge are gearing up to provide high value products and services in conjunction with software houses in particular, products with embedded software. In this regard, India may be several steps ahead of China.

[28] In 2004, 15 percent of the production was exported (Balakrishnan and others 2006). China was a net exporter of vehicles in 2005 to the tune of about 10,000 ("Figures Show China" 2006). Most of the exports comprised of minivans mainly to the Middle East but this is likely to change with increasing exports of sedans.
[29] The earliest entry was by GM, assembling Chevrolets in India in 1928 (KPMG International 2006).
[30] Most of the Indian automotive exports are done by the international first tier suppliers (Balakrishnan and others 2006).
[31] Among the top 10 firms in terms of R&D spending, five are automotive firms, led by DaimlerChrysler (Department of Trade and Industry 2005).
[32] The market share of Maruti Udyog is 54.5 percent in passenger cars with the capacity to produce 500,000 units annually ("Smooth Drive" 2006).

Table 2.9 Exports of Automotive Products, 1990–2004

	Value (million dollars)			Share in economy's exports (percent)	
	1990	2000	2004	2000	2004[b]
World	318959	575650	847240	9.2	9.5
Brazil	2034	4682	8679	8.5	9.0
China	258	1581	6272	0.6	1.1
EU (25)	–	287190	470792	11.8	12.7
India	198	640	1318[a]	1.4	2.3
Japan	66195	88082	115733	18.4	20.5
Korea	2301	15194	32320	8.8	12.7
Malaysia	121	307	554	0.3	0.4
Mexico	4708	30655	31558	18.4	16.7
Thailand	108	2401	5713	3.5	5.9
United States	32547	67195	76417	8.6	9.3

Source: WTO, "International Trade Statistics 2005," Table IV.67.
a. From 2003.
b. Or latest year.

Both China and India are beginning to worry about the environmental impact of their rapid motorization and they share similar concerns about energy security and dependence on imported oil. As a result, China and India may be able to help push the technological frontier for the fuel efficient, small, and clean cars made with predominantly recyclable material and parts but only if they set and enforce appropriate environmental standards (Gallagher 2006; Noble 2006). Recently Toyota began assembling the Prius hybrid car in China, a technology well suited for China's cities and a technological direction appropriate for a world in which petroleum consumption threatens to rapidly overtake the feasible growth in supplies.[33]

Steel

China's steel production passed the 349 million ton mark in 2005 making it by far the largest producer in the world (with 31 percent of the global share) and the fourth largest exporter, with sales of 27 million tons approximately on par with imports.[34] The important developments with portent for the future are the extremely rapid increases in capacity—25 percent between 2004 and 2005 alone—the increasing concentration of production in large sized modern plants (although many small antiquated facilities remain)[35] and the growing technological capacity to produce high quality construction steel, stainless, galvanized, and coated steels and flat products for burgeoning downstream transport and durable goods industries. These developments point to declining imports and the scope for higher exports.

Compared to China, India's total output and per capita consumption is small. By 2004–05, India was producing 38 million tons of steel and its exports of 3.8 million tons approximately balanced imports of 3.2 million tons. As India enlarges its transport, engineering and white goods industries and modernizes its severely backward infrastructure, the demand is likely to rise as

[33] Hyundai is planning to market a hybrid version of its Accent in China by 2008 ("Automotive" 2006).
[34] In December 2005, China became a net exporter.
[35] Closing down small inefficient plants and consolidating production in a few giant firms is a government objective ("Attempting a Steel Revolution" 2005).

sharply as it has done in China. Thus, it is realistic to expect India to produce 55–60 million tons of steel by 2010 and as much as 120–130 million tons by 2015.

The production trends in China and India will have consequences for the rest of the world. One is that the capacity expansion in China and India will enormously add to the demand for iron ore and coking coal (unless production of steel plummets elsewhere) and to the extent that this cannot be met through the development of local mines and associated transport facilities, it will spillover into imports. Two, Indian production is still largely of mild steels. To a lesser extent so is China's. Only Tata's most modern plant is beginning to meet the needs of the auto industry for hot rolled steel.[36] A considerable amount of investment, learning and gains in process technologies might be needed before even China and certainly India can meet the requirements of its own advancing transport and engineering industries. For the above reasons, India is not likely to emerge as a significant exporter of steel, and especially of high tech and specialty steels, during the next decade. More probably if infrastructure, housing, and industrial development take-off, India would for a time be an importer of certain types of specialized steels as very likely, would China. However, China is sure to ascend the ranks of steel exporters, edging out the EU25 and possibly Russia within 5 years.

Electronics

Competition, globalization, indigenization, and powerful policy factors have been the forces driving the electronics industries in China and India. Further impetus at least for China has come from the outsourcing of manufacturing from Taiwan (China), the U.S., Japan, and Europe in the 1990s. However, the development of each country's electronics industry has been shaped by different industrial policies.

India's policy framework has focused on technological self-reliance and assigned a limited role to foreign investment and to the development of electronic components manufacturing, which has contributed to the success of the industry in Taiwan (China) (Joseph 2004). The Electronics Commission established in 1971 promoted protectionist policy measures to control production capacity, investment, and imports. The strategy channeled the development of the electronics industry to the public and small-scale sectors, in addition to regulating the entry and operation of foreign capital and technology. Discontent with the policies emphasizing self-reliance and with restrictive industrial policies in general, has led to a gradual liberalization of the electronics industry (Gokarn, Sen, and Vaidya 2004).

By 2004–2005, the production of electronics hardware in India amounted to $11.1 billion of which one-third was from consumer electronics. Leading the increase in consumer electronics production is the production of color TVs, which was over 10 million units in 2004–2005. Gradually the production of color TVs is shifting towards flat screen TV (based on tubes), and more advanced flat panels such as LCD and Plasma TVs (as it also is in China, although mastering the latest generation of this technology is proving difficult for domestic producers). Backward linkages have encouraged investment in some types of component manufacturing, for example, India is the world's third largest manufacturer of optical storage media with 18.5 percent of the global market. Around 80 percent of the production is exported to 82 different countries.

The shipment of PCs in India reached 2.34 million units in the first half of 2005–06, a 36 percent increase compared to the same period in 2004–5. The growth of computer production is

[36] Tata's earnings before interest, tax, depreciation and amortization were $293 per ton in 2005, three times the average of the industry. ("Tata Steel Girds" 2006).

driven by the wider adoption of PCs by businesses, various government agencies, and affordable broadband connections. Currently there are 800,000 broadband subscribers but this is expected to increase to 10 million by the end of 2007, further fueling the demand for PCs.

China's path towards achieving a flourishing electronics sector approximates the development in other NIEs. China has attached strategic importance to the electronics sector for decades and developed electronics capability over the course of a succession of "Five Year Plans" (FYP), initially to meet defense needs, those of the industrial sector and to a lesser degree, those of households for electronic appliances, mainly radios. With increasing consistency it has compelled foreign investors to transfer technology to local producers and gradually this strategy is yielding results (Rodrik 2006). The seventh (1986–90), eighth (1991–95), and ninth FYP's (1996–2000) witnessed a dramatic surge in the production of consumer electronic products with an average annual growth rate of around 66 percent. By the ninth FYP (1996–2000), the output of the electronics sector amounted to $72 billion, and exports had climbed to around $35 billion. Alongside manufacturing capability, China also strengthened its technological capacity through investment in R&D and was able to develop a number of products such as VLSI devices, the Panda ICCAD system, and rewritable CDs. This period also witnessed the emergence of new companies such as Changhong Electric, Tsinghua Tongfang, Caihong Electronics, Panda, and Lianxiang, and numerous Taiwanese transplants all of which have since enabled China to become the leading manufacturer of color TVs, LCDs, laptops, PCs, color tubes, program controlled switchboards, cell phones, display devices and monitors (Pecht and Chan 2004).[37]

By leveraging its low cost labor supplies and the impetus gained from WTO accession, China has doubled the scale of the electronics industry and it accounts for more than 8 percent of industrial output—while in India by comparison electronics sub-sector accounts for less than 3 percent of a much smaller industrial sector.

In a little more than a decade, China has made the transition from the limited production of low quality electronic products to partaking in the global production chain for a wide spectrum of finished products and components (Fernandez and Underwood 2006). Today, there are over 10,000 foreign-invested firms in China and it is likely that many more foreign component producers will relocate because of lower labor costs, tax incentives,[38] a large domestic market, and adequate infrastructure. Companies such as Intel and Motorola have taken the lead in promoting electronics R&D in China—Intel has opened a test and assembly plant in Chengdu and Motorola is investing over half-a-billion dollars in a R&D facility in Beijing. Leading Taiwanese firms such as Hon Hai Precision and Quanta are doing the same. In addition, Chinese universities have created linkages with institutes/universities abroad, and are attempting to gain access to advanced technologies. The future of China's electronics industry lies in its ability to transition from a still relatively low skilled, labor-intensive sector towards an IT-enhanced electronics manufacturing sector (Sigurdson 2005).

On the other hand, India's shortcomings in both the private and public sectors have been marked by a strong reliance on imported technology and inadequate R&D—a shift from import-induced to R&D-induced technology would be beneficial for the electronics industry. Belatedly,

[37] While Chinese companies are catching up, the principal exporters of the high end electronics products such as laptops and DVDs are Taiwanese companies such as FoxConn, Techfront and Magnificent Brightness (Branstetter and Lardy 2006).

[38] See Yang (2006) who foresees a further expansion of China's processing trade assisted by the International Technology Agreement, a part of the WTO accession but does not anticipate a shift of high value components to China for some time. Foreign firms in China receive a tax exemption during the first two years and a 50 percent reduction of the full rate for three years due after the first profitable year—this is in contrast to the U.S. and Japan were corporate tax rates are respectively 35 (Federal rate) percent and 42 percent (Pecht and Chan 2004).

India is now attempting to overcome these by making significant concessions to export-oriented firms, and as a result India has experienced an increase in exports. But, liberalization is also leading to competition from imports and a decline in profits across industry branches. The Indian electronics industry must now compete with China to gain a share of the gap left by the newly industrialized countries (NICs), all the while maintaining its lead in the export of electronics software.[39]

Concluding Observations

This bird's eye view of industrial capabilities in China and India leads us to the following observations on the evolution of global industrial geography. First that the rapid buildup of industrial capability in China across a wide range of subsectors is quite remarkable and shows how the codification of technology, its diffusion through FDI and trade, its harnessing by investment in human capital, in plant and equipment in infrastructure and organizational skills, have changed the rules of the game. Catching up and leapfrogging has become easier if countries have the policy determination, the ability to mobilize capital and build the infrastructure to generate skills. Second, larger countries do enjoy scale economies and are better placed to attract FDI and induce MNCs to transfer technology. China has achieved a commanding lead in major low, medium, and high tech industries which it may be in a position to consolidate and enlarge over the next decade and a half (Devlin, Estevadeordal, and Rodriguez-Clare 2006; Lall and Albaladejo 2004; Roland-Holst and Weiss 2005). While many complex capital goods, components and design and research intensive products are likely to remain the preserve of the advanced countries, China's industrial strength could put pressure on manufacturing industries in middle and low income countries and force them to rethink, narrow and focus their industrial ambitions. Survival will depend on achieving industrial and innovation capability that equals or exceeds China's. Innovation may drive competitiveness and other countries must match or exceed China's own investment in its innovation system.

India is likely to be a major force in the software, business processes and consulting industries including design and engineering services competing not so much with the leaders such as the U.S., Germany, and Japan but with the mid-range and lower-end players, including China which might soon enjoy an edge in terms of the volume of technical skills. India is certain to build manufacturing capability but at least during the coming decade, there is only a slim prospect of it emerging as an exporter on the scale of China in mass produced consumer products in key industries such as electronics, autos and auto parts. More likely it could emerge as a force in certain kinds of engineering products and services that leverage its skill base including software skills. India's many institutional bottlenecks, gaps in the infrastructure and emerging shortages of skills will remain a drag on industrial advance.

There is no doubt that China will be a formidable competitor for labor intensive manufactures that depend on semi-skilled, disciplined, and low wage work force for at least another decade, and India, if the domestic and international regulatory environment allows it, can become a major competitor in this area as well.[40]

[39] Signs that India is attracting the MNCs are supported by IBM's announced intention of investing $6 billion in India and the investment of $3.9 billion by Microsoft, Intel and Cisco ("IBM to Build" 2006).

[40] Recent trends also suggest that the two countries could develop significant bilateral trade links as well (Wu and Zhou 2006).

The world, however, is not going to be divided into China and India as the main suppliers to the world market of manufactures and business services while the rest of the world specializes in natural resource and arable land based products. The world has not repealed the theory of comparative advantage. China's very success in so many areas of manufacturing points to the forces that are going to gradually change China's competitive position. Wages in the coastal areas of China are already rising to a level sufficient to reduce the country's competitiveness at the labor intensive end. Movement of these plants to areas where wages are still low will postpone the day when China will have to abandon many of these sectors, but the rapid movement of workers to China's cities will raise incomes in the countryside and will thereby force up wages in the nation's interior as well. Indian low wage manufacturers (along with those in other low wage countries), with the right policies, may be major beneficiaries of China's rising wages just as China benefited from the rapid increase in wages in Korea, Taiwan (China) and Hong Kong (China) over the past two plus decades.

India, in these respects, is in a very different position than China. With the right mix of policies, India's labor intensive manufactures can benefit significantly from China's rising wages and revaluing currency. India could become a major world exporter on the scale of China and will over time experience rapidly rising wages, but that is not a realistic prospect over the coming decade.

Finally, one must be careful not to assume that because China and India can produce hundreds of thousands of scientists and engineers each year, that they will soon dominate the high end of all manufactures and services world wide. Because China and India are very large countries with rapidly expanding modern industrial and service sectors, they require a large number of engineers and scientists to staff a wide range of activities in their own countries. China and India will be able to create and in some cases already have created world class research in the more advanced technologies, but they do have the qualified personnel to do this in only limited areas.

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